IMPERIAL AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

MGIPC—S4—III 1 93—22 8-45—5 000.

SCIENCE

Vol 74 — Friday, July 3, 1931 — No 1905

The American Association for the Advancement of Science
Race and Progress Professor Franz Boas 1

Obituary
Samuel Wilson Parr Professor Roger Adams *Memorials, Recent Deaths* 8

Scientific Events.
Isle Royale National Park, Officers of the American Institute of Electrical Engineers, Award of the Prizes of the Research Corporation, The Harvard Department of Physics, Honorary Degrees for Scientific Men 9

Scientific Notes and News 11

Discussion
The Position of Science in Soviet Russia Professor H M Dadourian *Hormones in Cancer* Dr. Fritz Bischoff, Dr. L C Maxwell and Dr H J Ullmann *Hemophilia* · Dr. Carroll La Fleur Birch *Glauconite in Fossil Foraminiferal Shells* Dr A L. Dryden, Jr. 15

Scientific Books
Newton's Opticks Professor W F Magie 18

Scientific Apparatus and Laboratory Methods
An Electrical Drop Counter Seward E Owen *Paper Apron to Prevent Curling of Microtome Sections* Professor F A Varrelman 19

Special Articles
The Agglutinating Action of Agar on Bacteria Dr Theobald Smith *Intelligence and Body Chemistry* Dr Gilbert J Rich 21

Index to Volume 73 i

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y

Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

RACE AND PROGRESS[1]

By Professor **FRANZ BOAS**

COLUMBIA UNIVERSITY

Permit me to call your attention to the scientific aspects of a problem that has been for a long time agitating our country and which, on account of its social and economic implications, has given rise to strong emotional reactions and has led to varied types of legislation. I refer to the problems due to the intermingling of racial types

If we wish to reach a reasonable attitude, it is necessary to separate clearly the biological and psychological aspects from the social and economic implications of this problem. Furthermore, the social motivation of what is happening must be looked at not from the narrow point of view of our present conditions but from a wider angle

The facts with which we are dealing are diverse The plantation system of the south brought to our shores a large Negro population Considerable mixture between white masters and slave women occurred during the period of slavery, so that the number of pure Negroes was dwindling continually and the colored population gradually became lighter A certain amount of intermingling between White and Indian took place, but in the United States and Canada this has never occurred to such a degree that it became an important social phenomenon In Mexico and many parts of Central and South America it is the most typical case of race contact and race mixture With the development of immigration the people of eastern and southern Europe were attracted to our country and form now an important part of our population They differ in type somewhat among themselves, although the racial contrasts are much less than those between Indians or Negroes and Whites Through Mexican and West Indian immigration another group has come into our country, partly of South European, partly of mixed Negro bodily form is not known, but the influences of outer conditions have to be taken into consideration when comparing different human types.

---

[1] Address of the president of the American Association for the Advancement of Science, Pasadena, June 15

Selective processes are also at work in changing the character of a population Differential birth-rate, mortality and migration may bring about changes in the hereditary composition of a group The range of such changes is limited by the range of variation within the original population The importance of selection upon the character of a population is easily overestimated It is true enough that certain defects are transmitted by heredity, but it can not be proved that a whole population degenerates physically by the numerical increase of degenerates These always include the physically unfit, and others, the victims of circumstances The economic depression of our days shows clearly how easily perfectly competent individuals may be brought into conditions of abject poverty and under stresses that only the most vigorous minds can withstand successfully Equally unjustified is the opinion that war, the struggle between national groups, is a selective process which is necessary to keep mankind on the onward march Sir Arthur Keith, only a week ago, in his rectoral address at the University of Aberdeen is reported to have said that "Nature keeps her human orchard healthy by pruning and war is her pruning hook" I do not see how such a statement can be justified in any way War eliminates the physically strong, war increases all the devastating scourges of mankind such as tuberculosis and genital diseases, war weakens the growing generation History shows that energetic action of masses may be released not only by war but also by other forces We may not share the fervor or believe in the stimulating ideals, the important point is to observe that they may arouse the same kind of energy that is released in war. Such a stimulus was the abandonment to religion in the middle ages, such is the abandonment of modern Russian youths to their ideal

So far we have discussed the effects of heredity, environment and selection upon bodily form We are not so much concerned with the form of the body as with its functions, for in the life of a nation the activities of the individual count rather than his appearance. There is no doubt in my mind that there is a very definite association between the biological make-up of the individual and the physiological and psychological functioning of his body The claim that only social and other environmental conditions determine the reactions of the individual disregards the most elementary observations, like differences in heart beat, basal metabolism or gland development; and mental differences in their relation to extreme anatomical disturbances of the nervous system. There are organic reasons why individuals differ in their mental behavior.

But to acknowledge this fact does not mean that all differences of behavior can be adequately explained on a purely anatomical basis When the human body has reached maturity, its form remains fairly stable until the changes due to increasing age set in. Under normal conditions the form and the chemical constitution of the adult body remain almost stable for a number of years Not so with bodily functions The conditions of life vary considerably. Our heart beat is different in sleep and in waking It depends upon the work we are doing, the altitude in which we live, and upon many other factors It may, therefore, well be that the same individual under different conditions will show quite different reactions It is the same with other bodily functions The action of our digestive tract depends upon the quality and quantity of the food we consume In short, the physiological reactions of the body are markedly adjusted to conditions of life Owing to this many individuals of different organic structure when exposed to the same environmental conditions will assume a certain degree of similarity of reaction

On the whole it is much easier to find decided differences between races in bodily form than in function It can not be claimed that the body in all races functions in an identical way, but that kind of overlapping which we observed in form is even more pronounced in function It is quite impossible to say that, because some physical function, let us say the heart beat, has a certain measure, the individual must be White or Negro—for the same rates are found in both races A certain basal metabolism does not show that a person is a Japanese or a White, although the averages of all the individuals in the races compared may exhibit differences. Furthermore, the particular function is so markedly modified by the demands made upon the organism that these will make the reactions of the racial groups living under the same conditions markedly alike. Every organ is capable of adjustment to a fairly wide range of conditions, and thus the conditions will determine to a great extent the kind of reaction.

What is true of physiological function is equally true of mental function There exists an enormous amount of literature dealing with mental characteristics of races. The blonde North-Europeans, South Italians, Jews, Negroes, Indians, Chinese have been described, as though their mental characteristics were biologically determined. It is true, each population has a certain character that is expressed in its behavior, so that there is a geographical distribution of types of behavior. At the same time we have a geographical distribution of anatomical types, and as a result we find that a selected population can be described as having a certain anatomical type and a certain kind of behavior. This, however, does not justify us in claiming that the anatomical type determines behavior. A great error is committed when we allow ourselves to draw this inference. First of all it would be necessary to prove that the correlation between bodily form and behavior is absolute, that it is valid not only for the selected spot, but for the whole population of the given type, and, conversely, that the same behavior does not occur when the types of bodily build differ. Secondly, it would have to be shown that there is an inner relation between the two phenomena.

I might illustrate this by an example taken from an entirely different field. A particular country has a specific climate and particular geological formation. In the same country is found a certain flora. Nevertheless, the character of soil and climate does not explain the composition of the flora, except in so far as it depends upon these two factors. Its composition depends upon the whole historical evolution of plant forms all over the world. The single fact of an agreement of distribution does not prove a genetic relation between the two sets of observations. Negroes in Africa have long limbs and a certain kind of mental behavior. It does not follow that the long limbs are in any way the cause of their mental behavior. The very point to be proved is assumed as proved in this kind of argumentation.

A scientific solution of this problem requires a different line of approach. Mental activities are functions of the organism. We have seen that physiological functions of the same organism may vary greatly under varying conditions. Is the case of mental reactions different? While the study of cretins and of men of genius shows that biological differences exist which limit the type of individual behavior, this has little bearing upon the masses constituting a population in which great varieties of bodily structure prevail. We have seen that the same physiological functions occur in different races with varying frequency, but that no essential qualitative differences can be established. The question must be asked whether the same conditions prevail in mental life.

If it were possible to subject two populations of different type to the same outer conditions the answer would not be difficult. The obstacle in our way lies in the impossibility of establishing sameness of conditions. Investigators differ fundamentally in their opinion in regard to the question of what constitutes sameness of conditions, and our attention must be directed, therefore, to this question.

If we could show how people of exactly the same biological composition react in different types of environment, much might be gained. It seems to me that the data of history create a strong presumption in favor of material changes of mental behavior among peoples of the same genetic composition. The free and easy English of Elizabethan times contrasts forcibly with the prudish Mid-Victorian, the Norse Viking and the modern Norwegian do not impress us as the same, the stern Roman republican and his dissolute descendant of imperial times present striking contrasts.

But we need more tangible evidence. At least in so far as intelligent reaction to simple problems of everyday life is concerned, we may bring forward a considerable amount of experimental evidence that deals with this problem. We do not need to assume that our modern intelligence tests give us a clue to absolutely biologically determined intelligence—whatever that may mean—they certainly do tell us how individuals react to simple, more or less unfamiliar, situations. At a first glance it would seem that very important racial differences are found. I refer to the many comparative tests of the intelligence of individuals of various European types and of Europeans and Negroes. North Europeans tested in our country were found as a whole decidedly superior to South Europeans, Europeans as a whole to Negroes. The question arises, what does this mean? If there is a real difference determined by race, we should find the same kind of difference between these racial types wherever they live. Professor Garth has recently collected the available evidence and reaches the conclusion that it is not possible to prove a difference due to genetic factors, that rather all the available observations may be easily explained as due to differences in social environment. It seems to me the most convincing proof of the correctness of this view has been given by Dr. Klineberg, who examined the various outstanding European types in urban and rural communities in Europe. He found that there is everywhere a marked contrast between rural and urban populations, the city giving considerably better results than the country and that furthermore the various groups do not follow by any means the same order in city and country, that the order rather depends upon social conditions, such as the excellence of the school systems and conflicts between home and school. Still more convincing are his observations on Negroes. He examined a considerable number of Negroes in southern cities who had moved to the city from rural districts. He found that the longer they lived in the city the better the results of the tests came to be, so that Negroes who had lived in the city for six years were far superior to those who had just moved to the city. He found the same result when studying Negroes who had moved from the south to New York, an improvement with the time of residence in New York This result agrees with Brigham's findings for Italians who had lived for varying periods in the United States It has often been claimed, as was done in the beginning by Brigham, that such changes are due to a process of selection, that more poorly endowed individuals have migrated to the country in late years and represent the group that has just come to the city It would be difficult to maintain this in view of the regularity with which this phenomenon reappears in every test Still, Dr Klineberg has also given definite evidence that selection does not account for these differences He compared the records of the migrating groups with those who remained behind The records collected in Nashville and Birmingham showed that there is no appreciable difference between the two groups The migrants were even a little below those who stayed at home He also found that the migrants who came to New York were slightly inferior to those who remained in the South

I have given these data in some detail, because they show definitely that cultural environment is a most important factor in determining the results of the so-called intelligence tests In fact, a careful examination of the tests shows clearly that in none of them has our cultural experience been eliminated City life and country life, the South and the North present different types of cultural background to which we learn to adapt ourselves, and our reactions are determined by these adaptations, which are often so obscure that they can be detected only by a most intimate knowledge of the conditions of life We have indications of such adaptations in other cases. It would seem that among the Plains Indians the experience of girls with bead work gives to them a superiority in handling tests based on form It is highly desirable that the tests should be examined with greatest care in regard to the indirect influence of experience upon the results I suspect strongly that such influences can always be discovered and that it will be found impossible to construct any test in which this element is so completely eliminated that we could consider the results as an expression of purely biologically determined factors

It is much more difficult to obtain convincing results in regard to emotional reactions in different races No satisfactory experimental method has been devised that would answer the crucial question, in how far cultural background and in how far the biological basis of personality is responsible for observed differences There is no doubt that individuals do differ in this respect on account of their biological constitution It is very questionable whether the same may be said of races, for in all races we find a wide range of different types of personality All that we can say with certainty is that the cultural factor is of greatest importance and might well account for all the observed differences, although this does not preclude the possibility of biologically determined differences The form of response of groups of the same race but culturally different is so great that it seems likely that any existing biological differences are of minor importance I can give only a few instances The North American Indians are reputed as stoic, as ready to endure pain and torture without a murmur This is true in all those cases in which culture demands repression of emotion The same Indians, when ill, give in to hopeless depression Among closely related Indian tribes certain ones are given to ecstatic orgies, while others enjoy a life running in smooth conventional channels The buffalo hunter was an entirely different personality from the poor Indian who has to rely on government help, or who lives on the proceeds of land rented by his White neighbors Social workers are familiar with the subtle influence of personal relations that will differentiate the character of members of the same family Ethnological evidence is all in favor of the assumption that hereditary racial traits are unimportant as compared to cultural conditions As a matter of fact, ethnological studies do not concern themselves with race as a factor in cultural form From Waitz on, through Spencer, Tylor, Bastian to our times, ethnologists have not given serious attention to race, because they find cultural forms distributed regardless of race

I believe the present state of our knowledge justifies us in saying, that while individuals differ, biological differences between races are small There is no reason to believe that one race is by nature so much more intelligent, endowed with great will power, or emotionally more stable than another, that the difference would materially influence its culture Nor is there any good reason to believe that the differences between races are so great, that the descendants of mixed marriages would be inferior to their parents. Biologically there is neither good reason to object to fairly close inbreeding in healthy groups, nor to intermingling of the principal races

I have considered so far only the biological side of the problem In actual life we have to reckon with social settings which have a very real existence, no matter how erroneous the opinions on which they are founded Among us race antagonism is a fact, and we should try to understand its psychological significance For this purpose we have to consider the behavior not only of man, but also of animals. Many animals live in societies. It may be a shoal of fish which any individuals of the same species may join, or a swarm of mosquitoes. No social tie is apparent in these groups, but there are others which we may call closed societies that do not permit any outsider to join their group. Packs of dogs and well-organized herds of higher mammals, ants and bees are examples of this kind. In all these groups there is a considerable degree of social solidarity which is expressed particularly by antagonism against any outside group. The troops of monkeys that live in a given territory will not allow another troop to come and join them. The members of a closed animal society are mutually tolerant or even helpful. They repel all outside intruders.

Conditions in primitive society are quite similar. Strict social obligations exist between the members of a tribe, but all outsiders are enemies. Primitive ethics demands self-sacrifice in the group to which the individual belongs, deadly enmity against every outsider. A closed society does not exist without antagonisms against others. Although the degree of antagonism against outsiders has decreased, closed societies continue to exist in our own civilization. The nobility formed a closed society until very recent times. Patricians and plebeians in Rome, Greeks and barbarians, the gangs of our streets, Mohammedan and infidel, and our modern nations are in this sense closed societies that can not exist without antagonisms. The principles that hold societies together vary enormously, but common to all of them are social obligations within the group, antagonisms against other parallel groups.

Race consciousness and race antipathy differ in one respect from the social groups here enumerated. While in all other human societies there is no external characteristic that helps to assign an individual to his group, here his very appearance singles him out. If the belief should prevail, as it once did, that all red-haired individuals have an undesirable character, they would at once be segregated and no red-haired individual could escape from his class no matter what his personal characteristics might be. The Negro, the East Asiatic or Malay who may at once be recognized by his bodily build is automatically placed in his class and not one of them can escape being excluded from a foreign closed group. The same happens when a group is characterized by dress imposed by circumstances, by choice, or because a dominant group prescribe for them a distinguishing symbol—like the garb of the Medieval Jews or the stripes of the convict—so that each individual, no matter what his own character may be, is at once assigned to his group and treated accordingly. If racial antipathy were based on innate human traits this would be expressed in interracial sexual aversion. The free intermingling of slave owners with their female slaves and the resulting striking decrease in the number of full-blood Negroes, the progressive development of a half-blood Indian population and the readiness of intermarriage with Indians when economic advantages may be gained by such means, show clearly that there is no biological foundation for race feeling. There is no doubt that the strangeness of an alien racial type does play an important rôle, for the ideal of beauty of the White who grows up in a purely White society is different from that of a Negro. This again is analogous to the feeling of aloofness among groups that are characterized by different dress, different mannerisms of expression of emotion, or by the ideal of bodily strength as against that of refinement of form. The student of race relations must answer the question whether in societies in which different racial types form a socially homogeneous group, a marked race consciousness develops. This question can not be answered categorically, although interracial conditions in Brazil and the disregard of racial affiliation in the relation between Mohammedans and infidels show that race consciousness may be quite insignificant.

When social divisions follow racial lines, as they do among ourselves, the degree of difference between racial forms is an important element in establishing racial groupings and in creating racial conflicts.

The actual relation is not different from that developing in other cases in which social cleavage develops. In times of intense religious feeling denominational conflicts, in times of war national conflicts take the same course. The individual is merged in his group and not rated according to his personal value.

However, nature is such that constantly new groups are formed in which each individual subordinates himself to the group. He expresses his feeling of solidarity by an idealization of his group and by an emotional desire for its perpetuation. When the groups are denominational, there is strong antagonism against marriages outside of the group. The group must be kept pure, although denomination and descent are in no way related. If the social groups are racial groups we encounter in the same way the desire for racial exogamy in order to maintain racial purity.

On this subject I take issue with Sir Arthur Keith, who in the address already referred to is reported to have said that "Race antipathy and race prejudice nature has implanted in you for her own end—the improvement of mankind through racial differentiation." I challenge him to prove that race antipathy is "implanted by nature" and not the effect of social causes which are active in every closed social group, no matter whether it is racially heterogeneous or homogeneous The complete lack of sexual antipathy, the weakening of race consciousness in communities in which children grow up as an almost homogeneous group, the occurrence of equally strong antipathies between denominational groups, or between social strata—as witnessed by the Roman patricians and plebeians, the Spartan Lacedaemonians and Helots, the Egyptian castes and some of the Indian castes—all these show that antipathies are social phenomena If you will, you may call them "implanted by nature," but only in so far as man is a being living in closed social groups, leaving it entirely undetermined what these social groups may be

No matter how weak the case for racial purity may be, we understand its social appeal in our society While the biological reasons that are adduced may not be relevant, a stratification of society in social groups that are racial in character will always lead to racial discrimination As in all other sharp social groupings the individual is not judged as an individual but as a member of his class We may be reasonably certain that whenever members of different races form a single social group with strong bonds, racial prejudice and racial antagonisms will come to lose their importance They may even disappear entirely As long as we insist on a stratification in racial layers, we shall pay the penalty in the form of interracial struggle Will it be better for us to continue as we have been doing, or shall we try to recognize the conditions that lead to the fundamental antagonisms that trouble us?

OBITUARY

SAMUEL WILSON PARR

SAMUEL WILSON PARR died at Urbana, Illinois, on May 16, following a heart attack. He was born on January 21, 1857, at Granville, Illinois Graduating from the University of Illinois with the A B degree in 1884, he continued his studies at Cornell University and received the M S degree in 1885 During 1900 and 1901 he was abroad at the University of Berlin and the University of Zurich Following six years as instructor and professor of general science at Illinois College, 1885–1891, he came to the University of Illinois as professor of applied chemistry, a position which he retained until 1926, when he became professor emeritus Even after retirement, however, he continued to carry on his researches

From the beginning Professor Parr was a leader During his undergraduate days he was an athlete, editor of the student paper, president of the literary society, president of the University Young Men's Christian Association and valedictorian of his class His versatility may be further appreciated when it is realized that on his return to the teaching staff of the University of Illinois seven years after leaving as a student, he became leader of the Glee Club

With Professor Arthur W Palmer he contributed much to the early development of the chemistry department at the University of Illinois. He was always a virile and interesting teacher, and in the early days when the facilities and stimulus for research in the university were lacking, he was always at work developing methods and means of experimentation which not only contributed much to knowledge and technique, but also inspired his students with ambition to accomplish something original

His scientific discoveries during his forty years of service to the University of Illinois are so numerous that only a few of those for which he was best known need be mentioned The Parr calorimeter for determining the heat value in coals and other hydrocarbons is used throughout the world The Parr peroxide bomb is found in the majority of analytical laboratories More recently he perfected another calorimeter for measuring and recording the heat value of fuel gases He made an extensive study of alloys and developed one in particular, "Illium," which has powerful acid-resisting properties and which has found wide application for replacing platinum in many types of equipment His study of boiler waters and their treatment was a very valuable contribution From the earliest days the study of the physical and chemical properties of coal was one of his prime interests, and the results of his investigations gave him an international reputation in this field He devised a most valuable "Classification of Coal" and developed a low temperature coking process to a point where it is just a question of time before it will become an important industrial process

Professor Parr was the author of many articles and bulletins and wrote a well-known text on "The Chemical Examination of Water, Fuel, Flue-Gases and Lubricants" The last few months of his life he devoted his remaining strength to a revision of this book Professor Parr was associated with many scientific and engineering organizations and technical committees and in each he had much influence. Among the recognitions that came to him were the Presidency of the American Chemical Society, the honorary degrees of doctor of science conferred by Lehigh University and by Illinois College, and the award of the Chandler Medal. Above all he will be remembered best for his genial and kindly personality, his modest and unassuming way which made and held many friends. He was a man of high character and high ideals, an inspiring teacher and an accomplished investigator

ROGER ADAMS

UNIVERSITY OF ILLINOIS

MEMORIALS

A FOUNDATION of $100,000, to be known as the Edward C Pickering Memorial, devoted principally to the study of variable stars by amateur astronomers, has been established at the Harvard Observatory The funds were advanced by Harvard University, the Rockefeller Foundation, and the American Association of Variable Star Observers According to the *Harvard Alumni Bulletin*, more than 300 of these amateur astronomers collaborate with the Harvard Observatory, they are scattered throughout the world In eighteen years the group working as members of the American Association of Variable Star Observers, with headquarters at the Harvard Observatory, has grown from a half-dozen enthusiastic amateurs, guided by Professor Pickering, to more than 100 during his lifetime, and to more than 300 since his death in 1919

RECENT DEATHS

DR HOBART AMORY HARE, professor of therapeutics and diagnosis at Jefferson Medical College, Philadelphia, has died at the age of 68 years

DR C H KAUFFMAN, emeritus professor of botany and emeritus director of the herbarium of the University of Michigan, died at his home in Ann Arbor on June 14 Professor Kauffman had been ill for sixteen months as the result of a paralytic stroke in February, 1930 He was sixty-two years of age

DR SHIBASABURO KITASATO, the distinguished bacteriologist, died in Tokyo on June 13, at the age of seventy-two years Dr Kanematsu Sugiura writes that his name has been connected with the following achievements Isolation of tetanus bacillus and bacillus of symptomatic anthrax in 1889, preparation of diphtheria antitoxin in 1890, discovery of the etiological agent of bubonic plague in 1894, isolation of dysentery bacilli in 1898, and preparation of effective antitoxin for the pneumonic plague in 1911

SCIENTIFIC EVENTS

ISLE ROYALE NATIONAL PARK

THE State of Michigan is proceeding with expedition to the creation of the Isle Royale National Park in Lake Superior, which it hopes will be the twenty-third in the chain of National Parks, according to information received by Secretary Wilbur at the Department of the Interior The Michigan Legislature has authorized the governor to appoint five commissioners to acquire and hold in trust for later transfer to the Federal Government lands for the proposed park. As soon as this commission is appointed the state will be in a position to acquire the areas needed

The Congress has authorized the acceptance into national park status of the Shenandoah area in Virginia and the Mammoth Cave in Kentucky on a similar basis The Michigan area will be number 23 only if it delivers title to the land in question in advance of these two.

The passage of this law by the Michigan Legislature creating a commission marks the first official step toward fulfilment of the requirements of the Act of Congress providing for the establishment of the Isle Royale National Park, approved by the President on March 3, 1931.

According to the authorization of Congress, Isle Royale will become a national park when all the lands of Isle Royale and as many of the numerous surrounding islands as the Secretary of the Interior shall designate shall be turned over to the Federal Government Following its customary procedure in authorizing the establishment of national parks, Congress specified that no federal appropriations should be made for the purchase of lands for the proposed park

The Michigan Conservation Commission is directed by the new law to transfer to the park commission more than 2,200 acres of state-owned Isle Royale lands Many private owners of Isle Royale lands have signified their intention of giving their holdings to the government, and it is expected that more than 50,000 acres of land will soon be held by the Isle Royale National Park Commission for transfer to the government at the proper time.

Isle Royale is the largest island in Lake Superior, having an area of about 135,000 acres Private holdings amount to nearly 124,000 acres Adding greatly to its charm and beauty, approximately 100 small islands surround Isle Royale, which is about 45 miles long and shaped like a narrow hand with the fingers toward the northeast

OFFICERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

CHARLES E SKINNER, assistant director of engineering, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, was elected president of the American Institute of Electrical Engineers for the year beginning August 1, 1931, as announced at the annual meeting of the institute held at Asheville, N C, on June 22, during the annual summer convention of the institute The other officers elected were *Vice-presidents*, W B Kouwenhoven, Baltimore, W E Freeman, Lexington, Paul H Patton, Omaha, A W Copley, San Francisco, L B Chubbuck, Hamilton, Ontario, *Directors*, L W Chubb, East Pittsburgh, B D Hull, Dallas, H R Woodrow, Brooklyn, *National Treasurer*, W I Slichter, New York (reelected)

These officers, together with the following hold-over officers, will constitute the Board of Directors for the next administrative year, beginning August 1 W S Lee (retiring president), Charlotte, N C, Harold B Smith, Princeton, Massachusetts, H V Carpenter, Pullman, Washington, G C Shaad, Lawrence, Kansas, I E Moultrop, Boston, H P Charlesworth, New York, T N Lacy, Detroit, J Allen Johnson, Buffalo, A M MacCutcheon, Cleveland, A E Bettis, Kansas City, J E Kearns, Chicago, F W Peck, Jr, Pittsfield, C E Stephens, New York, A B Cooper, Toronto, A E Knowlton, and R H Tapscott, New York

The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30, of 18,334 In addition to three national conventions and five district meetings, 1,628 meetings were held during the year by the local organizations of the institute in the principal cities and educational institutions in the United States, Canada and Mexico

AWARD OF THE PRIZES OF THE RESEARCH CORPORATION

THE Research Corporation prizes of $2,500 have been awarded through the Smithsonian Institution to Dr Andrew Ellicott Douglass, director of Steward Observatory of the University of Arizona, and Dr Ernst Antevs, of the University of Stockholm Each will likewise receive the Research Corporation plaque for outstanding contributions to science

The prize is awarded to Dr Douglass for his researches on the rings that mark the annual growth of trees which have thrown light on the past climate of the earth and on the correspondence between weather and solar activity The award to Dr Antevs was in recognition of his use of varves, layers of clay in ancient lake beds, as time-pieces of glacial activity

The awards to Drs Douglass and Antevs are the fourth and fifth of their kind made by the Research Corporation The first, in 1925, went to Dr John J Abel, of the Johns Hopkins University, for his work on ductless glands, animal tissues and fluids The second, in 1929, went to Dr Werner Heisenberg, of the University of Leipzig, for his contribution to matrix mechanics and for his exposition of the principle of indeterminance, and the third, also in 1929, to Dr Bergen Davis, of Columbia University, for the double x-ray spectrometer and other achievements in the field of atomic physics

The Research Corporation is the only organization of its kind It sprang from the desire of a scientific man to have the fruit of his scientific labors capitalized for the promotion of research In 1911, Dr Frederick G Cottrell, then chief physical chemist, later director of the U S Bureau of Mines, and his associates offered their invention for the electrical precipitation of suspended particles to the Smithsonian Institution, for the benefit of science As the institution could not well undertake the development of a matter so likely to have commercial and legal complications, Dr Charles D Walcott, then secretary of the Smithsonian, undertook with Dr Cottrell to enlist the aid of public spirited men of New York City to organize a non-profit sharing corporation for the development of the patents, and in 1912 the Research Corporation was formed

Its purposes are to acquire inventions and patents and make them more available in the arts and industries, while using them as a source of income, and, second, to apply all profits from such use to the advancement of technical and scientific investigation and experimentation through the agency of the Smithsonian Institution and other scientific institutions

THE HARVARD DEPARTMENT OF PHYSICS

THE *Harvard Alumni Bulletin* prints information concerning members of the department of physics as follows

> Professor Theodore Lyman is recuperating from a surgical operation for appendicitis, performed on May 10
>
> Professor William Duane also is convalescing from a serious illness He will be able during the coming summer, however, to direct research in the x ray laboratories of the new physics building and at the Huntington Hospital, Boston
>
> Professor P W Bridgman took part in a symposium on the physics of crystals, held at the first annual summer meeting of the American Association for the Advancement of Science, in Pasadena, on June 15. Later in the summer he will be engaged in writing at Randolph, New Hampshire During his absence from Cambridge, his research on the properties of matter under high pressure will be carried on by his assistants
>
> After a short vacation in New Hampshire, Professor F A Saunders will go on with his research in spectroscopy at the physics laboratory
>
> Professor Otto Oldenberg will remain in Cambridge during the summer for work in atomic physics
>
> Professor J C Slater, chairman of the department of

physics at the Massachusetts Institute of Technology, and lecturer on physics at Harvard, will give courses in the summer school of the University of California

Professors E L Chaffee and N H Black are on leave of absence in Europe Professor Chaffee is completing his text book on vacuum tubes, and Professor Black, who has attended courses at the University of Cambridge, will finish his study of the instruction in physics given at the English schools and colleges

Professor E C Kemble will spend the summer in Vermont, writing on quantum mechanics

Professor F H Crawford will take a brief vacation in Virginia and then return to Cambridge and continue his research on band spectra

J H McLeod will teach in the summer school and carry on research in atomic physics, D S Muzzey will work on supersonics, F V Hunt on architectural acoustics and R W Hickman on gas tubes H P Stabler will go to Williams College next year as an instructor in physics

The remodeling of the Jefferson Physical Laboratory will be completed during the summer, under the direction of H R Mimno, instructor in physics, who will also do research on power amplifiers

HONORARY DEGREES FOR SCIENTIFIC MEN

Among honorary degrees conferred by universities at their recent commencement exercises are the following

Yale University D Sc on Dr Eugene Lindsay Opie, professor of pathology and director of the department at the University of Pennsylvania, and director of the Henry Phipps Institute, Philadelphia, and on Mr John Ripley Freeman, civil and mechanical engineer, Providence, Rhode Island

Northwestern University D Sc on Dr Isaac Abt, member of the medical faculty of Northwestern University since 1894, and on Dr Robert Bruce Preble, professor of medicine at Northwestern University since 1895

The University of Pittsburgh D Sc on Dr Carl E Seashore, professor of psychology and dean of the Graduate School of the State University of Iowa

The University of Wisconsin D Sc on Dr Irving W Bailey, professor of plant anatomy at Harvard University

Middlebury College D Sc on Dr Albert W Hull, of the General Electric Company

Georgetown University LL D on Dr Felix Neumann, assistant librarian of the Army Medical Library at Washington, D C

Wilson College D Sc on Miss Francis Wick, professor of physics at Vassar College

Jefferson Medical College LL D on Dr Irving S Cutter, dean, Northwestern University Medical School

Earlham College LL D on Mr Orville Wright, of Dayton, Ohio, co inventor of the airplane

Brown University D Sc on Mr Ambrose Swasey, Cleveland, Ohio

University of Toronto D Sc on Dr L V Redman, vice president and director of research of the Bakelite Corporation and president elect of the American Chemical Society

SCIENTIFIC NOTES AND NEWS

The Roosevelt Memorial Association, New York, has awarded a Roosevelt Medal to Dr C Hart Merriam, chief of the U S Biological Survey from 1885 to 1910, and since research associate of the Smithsonian Institution, who "brought the study of natural history out of the laboratory into the open spaces of field and wood and sky"

Professor Dugald C Jackson, chairman of the electrical engineering department of the Massachusetts Institute of Technology, was on June 22 presented with the Lamme award for outstanding achievement in engineering teaching, at the annual dinner of the Society for the Promotion of Engineering Education at Purdue University More than five hundred persons attended the dinner, over which Dr Harold S Boardman, president of the University of Maine and president of the society, presided as toastmaster

Nature states that the portrait of Dr G Claridge Druce, which was subscribed for by members of the Botanical Society and Exchange Club of the British Isles on the occasion of his eightieth birthday on May 23, 1930, has been painted by Mr P A de Laszlo

The gold medal of the Royal College of Surgeons has been conferred on Mr G Buckston Browne, in recognition of his contributions to the surgery of the genito-urinary system, and of his gift of an endowment for an institution for surgical research

Dr Lecomte du Nouy, director of the department of biophysics of the Pasteur Institute, Paris, has been elected corresponding member of the Society of Biology of Vienna

Dr Carl E Correns, professor of botany at the University of Berlin, has been elected a foreign member of the Linnean Society, London

M H Lebesgue, professor of mathematics at the Collège de France, and Dr A. F Molengraaf, professor of geology at Delft, have been elected associates of the Royal Academy of Belgium.

The Albert Medal of the Royal Society of Arts for 1931 has been awarded by the council to H R H the

Duke of Connaught, "in grateful appreciation of his presidency of the society since 1911"

MEDALS of the Royal Geographical Society, London, were awarded at the annual meeting on June 20 as follows The Royal Patrons' Medal was awarded to Rear Admiral Richard E Byrd for his Antarctic expedition and his flights over the North and South Poles Captain William Galbraith, naval attache of the American Embassy, received the medal, formally presented by Admiral Sir William Goodenough, on behalf of Admiral Byrd The Founder's Medal was awarded to Bertram Thomas for his geographical work in Arabia and his successful crossing of the Rub-Al-Khali Desert The following four grants were presented The Murchison Grant to L M Nesbit for his difficult journey through the Danakil country of Abyssinia, the Back Grant to Colonel R H Rowe for his services in Nigeria and on the Gold Coast, the Cuthbert Peek Grant to H J L Beadnell for explorations in the Libyan Desert, and the Gill Memorial Grant to Michael Spender for studies of the Great Barrier Reef of Australia.

AT the anniversary meeting of the Linnean Society of London, held on May 28, the Linnean Gold Medal was awarded to Professor Karl Ritter von Goebel, professor of botany in the University of Munich Officers *of the society were elected as follows* Professor Frederick Ernest Weiss, F R S, *president;* Mr Francis Druce, *treasurer,* Mr John Ramsbottom, *secretary,* botany, and Lieut -Colonel John Stephenson, zoology

AT the eighty-fourth annual meeting of the British Paleontographical Society, held in London on May 29, Dr F A Bather, Mr Robert S Herries and Sir A Smith Woodward were reelected president, treasurer and secretary, respectively

MR. FRANK O CLEMENTS, technical director of the research laboratories of the General Motors Corporation, has been elected president of the American Society for Testing Materials

THE title of emeritus professor of biology has been conferred upon Professor Charles Wright Dodge, for the past forty-one years head of the department of biology in the University of Rochester Professor Dodge retired from active teaching at the close of the academic year

DR HARRIS J RYAN is retiring as head of the department of electrical engineering at Stanford University in order to devote his whole time to electrical research

DR. EARL BALDWIN MCKINLEY, formerly director of the School of Tropical Medicine of the University of Porto Rico and member of the medical faculty of Columbia University, has been appointed dean of the George Washington University School of Medicine to succeed Dean William Cline Borden, who becomes professor emeritus of medicine Dean Borden retired from active service in June, after twenty-two years as dean of the school of medicine. His services in the upbuilding of the medical school were recognized by the university at commencement on June 10 when the honorary degree of doctor of science was conferred on him

DR WILLIAM LORENZO MOSS has been appointed professor of preventive medicine and dean of the University of Georgia Medical Department to succeed Dr William H Goodrich, effective on July 1

DR CARL F CORI, formerly of the State Institute for the Study of Malignant Diseases, Buffalo, New York, has been appointed professor of pharmacology at the Washington University School of Medicine

DR RALPH C BENEDICT, at present chairman of the department of sciences at Haaren High School, New York City, has accepted the appointment of associate professor of biology at Brooklyn College He will continue to serve as resident investigator at the Brooklyn Botanic Garden, a position that he has held since 1916

DR M N SHORT, of the U S Geological Survey, has been appointed professor of optical mineralogy in the College of Mines and Engineering of the University of Arizona

DONALD C BOUGHTON has been appointed assistant professor of zoology and chairman of the reorganized department of biology at the Milwaukee center of the University of Wisconsin Extension Division. Other appointments in the department are Dr Benj. H Schlomovitz, lecturer in physiology, and Dr Ruth I Walker, in charge of botany

DR. E D FRIEDMAN, professor of neurology at New York University Medical School, has been promoted to the rank of visiting neurologist at Bellevue Hospital

MR. E M JELLENIK, formerly statistician for the United Fruit Company, has been appointed chief statistician of the Memorial Foundation for Neuro-Endocrine Research, Boston

DR. JOSEPH M LOONEY, acting professor of physiological chemistry and toxicology at Jefferson Medical College, has accepted appointment with the Memorial Foundation for Neuro-Endocrine Research as chief of laboratories at the Worcester (Mass.) State Hospital Dr Hugh T. Carmichael, of the department of medicine of Union University, Albany, New York, has been appointed resident psychiatrist on the research service of the hospital.

Mr S. H. McCrory has been appointed head of the newly organized Bureau of Agricultural Engineering of the U S Department of Agriculture, authorized by act of the last Congress This bureau takes the place of the Division of Agricultural Engineering of the Bureau of Public Roads Mr McCrory came to the department twenty-four years ago and for several years has been chief of the division that now becomes a bureau

Dr. Alfred L Kroeber, of the University of California, has been appointed visiting professor of anthropology at Columbia University

Dr Charles H Danforth, of Stanford University, has been appointed exchange professor at the Harvard Medical School for the coming year

Dr. W W Dimock, head of the department of animal pathology at the University of Kentucky, has been called to England as a guest of the British Bloodstock Agency, Ltd , of London, to confer with breeders and scientific men in regard to horse-breeding problems

Dr Robert L Pendleton has been granted a year's leave of absence from the post of professor of soil technology and head of the department of soils, at the College of Agriculture of the University of the Philippines, stationed at Los Baños He has undertaken a soil survey of China, which will involve actual field work in soil mapping, training a staff for the development of the work, etc. The soil survey will be a branch of the National Geological Survey of China, which has its headquarters and laboratories at Peiping

Under the auspices of Yale University, Dr Hellmut de Terra, formerly of the University of Berlin, now research associate in geology at Yale, will lead a scientific expedition to the Himalayas and western Tibet The personnel of the expedition will consist of Dr and Mrs. de Terra, Dr G Evelyn Hutchinson, a member of the Yale department of zoology, and George E. Lewis, fellow in vertebrate paleontology. The members of the expedition will start for India in February, 1932, where they expect to spend a year

James A G. Rehn, secretary and an associate curator of the Philadelphia Academy of Natural Sciences, is now on his way from São Paulo, Brazil, to Descalvados, 1,400 miles north of Rio de Janeiro, to join the Matto Grosso Expedition directed by Captain Vladimir Perfilieff, which already has spent several months in this "campo" country Mr Rehn will make a study of the bird, mammal, fish and insect life, and collect specimens for the academy's museum and its scientific collections.

Dr. Joseph B Niederl and Dr A Benedetti-Pichler, of the Department of Chemistry, Washington Square College, New York University, who are spending the summer in Germany and Austria, attended the Hauptversammlung des Vereins Deutscher Chemischer, held at Vienna from May 26 to May 30 Dr Niederl contributed papers on the quantitative microanalytical estimation of ethyl alcohol in human and animal organs, and on the addition of phenols to double bonds, and Dr Pichler on experiments, carried out with Professor Alexander O Gettler, on the isolation of ethyl alcohol from human organs Dr R H Muller contributed a paper on the application of photoelectric methods in precision colorimetry

At the commencement exercises of the Colleges of Medicine and Dentistry and the School of Pharmacy of the University of Illinois on June 13, the commencement address was given by Dr Edward H Kraus, dean of the College of Pharmacy, University of Michigan, on "Some Pertinent Aspects of Higher Education " At these exercises, the William Beaumont Prize of $100 for the best research on "Diseases of the Gastro-Intestinal Tract" was awarded to Dr Alexander J Nedzel, for work on "The Passage of Bacteria through the Splanchnic Body Surface " The University of Illinois Chapter of Sigma Xi Prize of $25 for the best original piece of scientific investigation by a student during the year was awarded to Morris A Kaplan, for a report on "A Modified Method for the Preparation of Hematoporphyrin "

The Committee on Scientific Research of the American Medical Association announces the award of a research grant to Professor Harry J Deuel, Jr , of the University of Southern California Medical School, for the study of glycogenesis and glycogenolysis in animals after the administration of various sugars, to Dr Daniel A McGinty, of the Emory University School of Medicine, for the continuation of studies on the blood in the coronary circulation, and to Dr W R Tweedy, associate professor in the department of physiological chemistry, Loyola University School of Medicine, Chicago, "for further purification of the parathyroid hormone."

The autumn meeting of the National Academy of Sciences will be held at Yale University on November 16, 17 and 18, 1931 Dr Yandell Henderson is secretary of the local committee on arrangements

Applications for the position of principal metallurgist must be on file with the U S Civil Service Commission at Washington, D C, not later than July 24. The examination is to fill vacancies in the Bureau of Mines, for duty in Washington, D C, at Pittsburgh, Pennsylvania, or elsewhere in the field. The entrance salaries range from $5,600 to $6,400 a year. Competitors will not be required to report for examination at any place, but will be rated on their education, training and experience.

The Rockefeller Institute has made a grant of $45,000 to Columbia University in aid of research on the common cold. The work is being undertaken at the Columbia-Presbyterian Medical Center by Dr. A. R. Dochez and Dr. Yale Kneeland, Jr., of the College of Physicians and Surgeons.

The Valentine's Meat Juice Company has made a grant of two thousand dollars a year for a period of three years to the Medical College of Virginia, Richmond, for the purpose of cooperative research in the basic sciences as related to medicine, dentistry, pharmacy and nursing.

An Associated Press despatch reports that an appropriation of $6,000,000 for an educational campaign on the proper care of the eyes was passed at the national convention of the American Optometric Association meeting in San Antonio. Dr. J. Fred Andreae, of Baltimore, the president, said that the appropriation would be spent in the next four years in newspapers, magazines and other mediums to stimulate interest in the problems of defective vision.

Building has begun on the new monkey house at the Johns Hopkins Medical School for the housing of the rhesus colony of the department of embryology, Carnegie Institution of Washington. Twenty paddocks and six breeding cages together with laboratory space will occupy the roof of the New Hunterian Building at the corner of Wolfe and Madison Streets. Several hundred monkeys may be accommodated under conditions which six years of study in Baltimore and experience at other places have shown are satisfactory for the rhesus monkey.

According to *The Museum News* the National Museum in Rio de Janeiro, Brazil, has been reorganized by the new government, with departments of mineralogy and petrography, stratigraphy and paleontology, botany (two sections), zoology (two sections), anthropology, ethnography, and educational work. The director of the museum, Dr. Edgard Roquette-Pinto, reports that during the past year expeditions have been sent out to the Island of Marajo to study Indian pottery, to Maranhao to study the tribes there, to Serra do Mar for botanical study and collecting, and to the valley of the Paraopeba River in Minas for zoological work. Educational work included lectures, motion picture showings, and loans of specimens and slides. Attendance for the year was 114,723.

The London *Times* states that the Royal research ship *Discovery II* arrived recently at Falmouth from South Georgia, after having been absent from England for about eighteen months on scientific research work in the Antarctic regions. In due course a report will be issued by the committee, of which Mr. E. R. Darnley, of Claygate, Surbiton, is the chairman, and Mr. F. H. Harper, of Putney, the secretary. The *Discovery II* has been engaged on research work on the coast of Graham Island, and has brought home two officers from the marine biological station at South Georgia, Mr. F. D. Omunney and Mr. F. J. Hary. The *Discovery II* was launched in November, 1929, on the Clyde, having been built for the *Discovery* Committee to the order of the Crown Agents for the Colonies.

A new ship, the *Atlantis*, built especially for scientific work at sea, is now on the way to America, but since she will go to work even on her maiden voyage she will not arrive at her destination until about the first of September. The *Atlantis*, built at Copenhagen for the Woods Hole Oceanographic Institution, will reach Woods Hole about September 1. Science Service reports that she is a steel boat of approximately 380 tons displacement, 142 feet long, 29 feet beam and 16 feet extreme draft. She carries a 250 Diesel engine, and can cruise under power alone for 3,000 miles at eight knots, with sail she can extend her radius indefinitely. She carries two laboratories and living accommodations for twelve or sixteen persons. She left Copenhagen for Plymouth, England, a few days ago, and will set sail from the latter port about July 10 for Woods Hole. On the way over she will turn from her course for two north-south profiles across the North Atlantic Drift, one on the longitude of the Azores, the other about fifty degrees west longitude. Another profile will be run off the coast of Nova Scotia. On these scientific runs special attention will be paid to the distribution of the smaller life of the sea in its relation to light penetration into the water and also to the capture of fish that swim at great depths. Chemical studies will also be made of the sea water at stations spaced between Europe and America. The physical studies will be in charge of the commander of the *Atlantis*, C. O. Iselin, the biological work will be conducted under Dr. George L. Clarke, and the chemical researches will be made by Dr. F. Zorell, of the Deutsche Seewarte.

Nature says that the issue by the British Association of a catalogue of the objects in the memorial rooms of Down House, Darwin's home at Farnborough, where he lived and worked for almost forty years, will be widely appreciated in view of the approaching centenary meeting of the association in London. Mr. Buxton Browne, the curator and generous donor of Down House to the British Association, "to be held in custody for the nation," has restored the memorial rooms as nearly as possible to the state in which they were when Darwin lived there. Much of the furniture is original, and, thanks to the generous assistance of members of the Darwin family and admirers of Darwin, the pictures and other objects and the articles which Darwin had in daily use are here in what was formerly their accustomed place. Among the latest acquisitions are selections from the letters (in facsimile) from Darwin to Fritz Muller, the German naturalist, who was Darwin's correspondent in Brazil between 1865 and 1882. These letters were acquired in 1929 by Professor Henry Fairfield Osborn, of the American Museum of Natural History, New York. Professor A. C. Seward, professor of botany in the University of Cambridge, has recently expressed his intention of placing on loan at Down House the major part of the Darwin Library, which was bequeathed by Sir Francis Darwin to the professor of botany in the university for the time being. The catalogue, which has been prepared by Mr. Buxton Browne and the secretary of the British Association, gives brief historical and descriptive notes on the house and grounds, and is illustrated.

DISCUSSION

THE POSITION OF SCIENCE IN SOVIET RUSSIA

I SHOULD like to add my impressions to Professor Cockerell's contribution in a recent number of SCIENCE. During my travels in the Soviet Union for three months last year, it was evident to me that science and the scientific method have assumed an importance in the minds of the Russian leaders second only to communism. In every town that I visited there were new scientific institutes. Small laboratories have been attached to almost every kind of establishment, from the experimental vineyards of the Transcaucasus to the kitchen factories of Moscow.

At the Academy of Sciences in Leningrad I made special inquiry whether research work is encouraged by the Soviet Government. Professor Paul Nikoforoff, the director of the Seismological Institute, who was a member of the staff before the revolution, was emphatic in affirming that research receives the greatest encouragement, and as evidence showed me a number of reprints of recent scientific investigations made by his department. He said that before the revolution the department had a staff of three men, including himself and Prince Galitzin. Last summer the department had a staff of seventy persons, located in twenty-five different stations in the Union. The government is building a 500,000-ruble seismological laboratory on the site of a building belonging to a pre-revolutionary beer baron. "The former wine cellars," he said, "will provide us with excellent constant temperature rooms." At the time of my visit several mechanics were busy in the machine shop with the construction of seismological instruments of a type recently developed by the department.

How is one to reconcile this situation with the reports of the plight of scientific men in the Soviet Union, particularly that of members of the Academy of Sciences? How can it be reconciled with the recent declaration of policy limiting research to the field of applied science?

This is one of the many contradictions which exist in Soviet Russia. For example, why are the Bolshevik leaders so ruthless in dealing with individuals, while at the same time they express sympathy with the lot of the under-dog? Why are they creating new classes, such as the disfranchised groups, while at the same time they profess to aim at a classless society?

In order to explain these and many other contradictions between Russian theory and practice, we must try to look into the minds of the Bolsheviks and to understand their point of view. If we do this we shall find that their principal anxiety is to safeguard the future of the revolution. In their determination not to repeat the mistakes of the French Revolution they are willing to sacrifice anything and everything that they suspect of contributing in the slightest measure to the possibility of counter-revolution. Their ruthlessness toward kulaks, toward private traders and toward engineers and scientists whom they suspect of having capitalistic leanings is due to this anxiety.

Furthermore, the Bolshevik leaders consider their country to be in a state of war, a war against the old order. They take their war even more seriously than we took the World War. If we refresh our memories with regard to some of the things that were done during the World War under the impulse of war psychology, in sending scientists into the trenches, in dealing with people suspected of sympathizing with the enemy, in committing to prison for ten to twenty years people who declared themselves to be opposed to war, we shall gain some inkling of the present psychology of Russian communists.

Another factor that affects the position of science in Russia is the question of *valuta*, that is, foreign currency to pay for imports. While there I heard complaints from engineers and scientists that they find it difficult to get scientific books and apparatus from abroad. If the government is eager to develop science and to educate engineers, why do they make it difficult to import scientific material? For the same reason that they are placing the people on starvation diet by exporting everything they can put their hands on, while bending all their energies toward the ultimate improvement of the economic condition of the people—namely, in order to make the revolution safe They are afraid of foreign aggression and are hectically working to industrialize the country before the countries of western Europe are in a position to attack them In order to secure themselves, through industrialization, against aggression, they sacrifice the present welfare of the people and the progress of science by exporting everything for any price obtainable and importing only the machinery and raw materials which are necessary for their industrial and agricultural program

The Russian leaders consider the completion of this program to be an absolute necessity. Everything else, however desirable, they place in the category of luxury which they must do without for the present That is why they are anxious to divert man power and material from pure science, which would be of value to them in the future, to applied science which they need badly now.

It seems to me that in view of the great value of pure science and the slowness with which it can be developed, the policy of expediency adopted by the Bolsheviks is a mistake But I feel confident that as soon as the present critical situation in Russia becomes easier, science, pure as well as applied, will find in the Soviet government one of its most generous supporters

H. M DADOURIAN

TRINITY COLLEGE,
HARTFORD, CONNECTICUT

HORMONES IN CANCER

THE conception that the extension of neoplasms is due to the lack or imbalance in growth-regulating hormones is old In the past two years we have been engaged in testing the effects of practically all the established hormones and many glandular products, such as the Sokoloff, Watermann and de Kromme, and Coffey-Humber extracts, upon transplantable rat sarcomas and carcinomas None of these extracts appreciably affected the rate of tumor growth or final mortality as judged by statistical analyses A possible exception to these findings was a crude extract of the anterior lobe of the hypophysis, which contained a standardized amount of growth hormone, a slight increase in the rate of tumor growth of dosed rats being noted.

We have resorted to irradiating the head of the animal with roentgen rays and implanting radon seeds into the pituitary region in an attempt to stop the activity or destroy this body Since such a treatment might affect the parathyroids and thyroids by back-scattering, experiments with parathyroid-thyroidectomized animals were also made.

In attempting to destroy the hypophyses the maximum dose of roentgen rays was applied to the rat's head, the body being protected by lead to minimize back-scattering effects Six series of experiments using twenty to thirty rats per series were performed. With sub-lethal doses of the rays and in a radon series the rate of tumor growth was significantly retarded during the period when the body weight curve remained stationary Doses insufficient to stop or retard body growth had little effect upon the rate of tumor growth It has been said that any state which decreases the nutrition of the body as a whole or the tissue in which a tumor is located decreases the rate of growth of the tumor This objection has been controlled in our experiments by starvation and poisoning by synthalin and heavy metals, both of which retarded body growth without affecting the rate of tumor growth The experiments with the roentgen ray indicate that the growth factor associated with the pituitary contributes to the regulation of both the rate of body growth and the rate of tumor growth The experiments with parathyroid-thyroidectomized animals showed that these glands have no demonstrable effect upon tumor growth.

In the experiments with the roentgen ray, radon and the pituitary growth hormone, no effect upon the incidence of tumor takes was noted

FRITZ BISCHOFF
L. C MAXWELL
H J ULLMANN

DEPARTMENT OF CANCER RESEARCH,
SANTA BARBARA COTTAGE HOSPITAL

HEMOPHILIA[1]

HEMOPHILIA or bleeders disease is a rare disease of the blood, which has a strong hereditary tendency. Only males have the disease, while it is transmitted through the unaffected female. The outstanding symptom of hemophilia is a tendency to excessive hemorrhage The bleeding may be spontaneous from any part of the body or it may follow a slight injury which would pass unnoticed by a normal individual. It is well known that a strong hemophiliac tendency exists in several of the royal families of Europe. The ill-fated Czarovitch of Russia was a high-grade hemophiliac. The present Crown Prince of Spain also suffers from this disease. In this disease the clotting time of the blood is greatly prolonged.

---

[1] Presented before the Chicago Society of Internal Medicine, February 23, 1931.

The results of our recent studies in this disease divide themselves into three parts:

(1) We have located a family of hemophiliacs in southern Illinois Their family records have been traced back 125 years, through six generations There have been sixteen bleeders in this family, seven of whom are living.

(2) Taking into consideration that only males have the disease, while it is transmitted through the unaffected female, one is forced to the conclusion that if the female can transmit the disease she must potentially have the disease Then there must be something in the female mechanism which holds the disease in abeyance The greatest difference between males and females is the sex organs. Working from this hypothesis we treated two high-grade hemophiliacs with ovarian extract, and performed an ovarian transplant on one of them. (The idea of the ovarian transplant was suggested by Dr H B Thomas and he performed the operation) The boy who received ovarian extract alone has been symptom free for eleven months The boy who had the ovarian transplant was completely well for five and one half months or until the transplant was absorbed We concluded from this experiment that in these two patients with hemophilia the introduction of the female sex hormone rendered them symptom free for eleven and five and one half months, respectively These boys had scarcely ever been free from hemorrhage for a month at a time prior to the institution of this treatment

(3) In our study of the blood we attempted to find the cause of the prolongation of the clotting time We found the blood platelets to be very resistant to hypo and hypertonic salt solution. When the resistance of the blood platelets was overcome mechanically the blood clotted in normal time.

We are continuing our study of hemophilia as our experiments are far from complete

CARROLL LA FLEUR BIRCH

COLLEGE OF MEDICINE,
UNIVERSITY OF ILLINOIS

GLAUCONITE IN FOSSIL FORAMINIFERAL SHELLS

THIS brief communication has two purposes (1) to add two more cases from the United States of glauconite occurring in fossil shells of foraminifera, (2) to question the following statement of Twenhofel "Although there may be some connection between foraminiferal shells and modern glauconites, it is difficult to find any evidence therefor in those of the geologic section."[1]

(1) The writer has been occupied in studying the sediments of the Calvert formation (Miocene) in Maryland In the field, these sediments show a predominantly light to dark olive-green color They overlie, unconformably, the highly glauconitic Eocene sands A laboratory study has revealed the surprising absence of glauconite, except as follows In Zone 13 (Miocene volume, Maryland Geological Survey), three miles below Chesapeake Beach pier, Calvert County, and at an elevation of 38½ to 45 feet, there occur a number of foraminifera which have in their interiors glauconite This substance is, in this case, a shiny, dark olive-green, in texture it resembles very fine fish-roe, the individual spheres being quite distinct The enclosing sediment is a dull, earthy olive-green, no grains of glauconite were seen outside the shells

In material from the Oligocene Vicksburg group of Mississippi (Brown's Cave, Leaf River), there are numerous foraminiferal shells bearing glauconite in their interiors Here the color is a somewhat dark peagreen, grains of glauconite are numerous in the enclosing sediment

(2) In the standard American literature on glauconite, the writer has seen but one specific reference to the occurrence of that substance in fossil foraminiferal shells, and that one is by R M Bagg, Jr[2] In that work no distinction is made between glauconite grains which might have been washed into the shells subsequently and glauconite which obviously formed in the shell itself

Some material from the Eocene of Chaumont, Paris Basin, furnished me together with that from the Oligocence of Mississippi by Dr. R E L Collins, of Johns Hopkins, shows conclusively that the glauconite now found in the shells had its origin there Several foraminifera were broken in mounting, and sections of the interior exposed In all cases the glauconite exactly fits, as a unit, the chamber in which it is found; no sign of finer texture can be seen, in all cases the "unit" of glauconite completely fills the chamber and conforms to all its irregularities In some cases only several of the innermost chambers are filled and the outer ones show no sign of ever having contained glauconite It seems impossible to explain such relations by appeal to subsequent filling

Twenhofel's statement, then, as quoted above, seems unwarranted, since in the Miocene example first described the evidence seems strongly to favor an origin of glauconite in the fossil shells and in the Eocene material from the Paris Basin no doubt can remain that such an origin must be postulated

A. L DRYDEN, JR

BRYN MAWR COLLEGE

---

[1] William H. Twenhofel, "Treatise on Sedimentation," p. 340, Baltimore, 1926.

[2] R M. Bagg, Jr, *Bull* 88, U S Geol Surv, 1898, p 13.

SCIENTIFIC BOOKS

Opticks or a Treatise of the Reflections, Refractions, Inflections and Colours of Light By Sir Isaac Newton, Knt Whittlesey House, McGraw-Hill Book Company, Inc, New York $2 50

This book is a reprint of the fourth edition of Newton's "Optics," which was printed in 1730 from a corrected copy of the third edition furnished the bookseller by Newton himself before his death There are prefixed to the text an enthusiastic foreword by Einstein and a short but clear and valuable introduction by Whittaker, in which the development of Newton's views on optical theory is discussed and some of the analogies between Newton's views and those of modern times are pointed out

In February, 1672, Newton presented to the Royal Society a paper on a "New Theory about Light and Colours" He begins with the analysis of sunlight by the prism and goes on to show, by a few fundamental experiments, that the different colors of the spectrum have an individuality which they do not lose by any subsequent reflections or refractions, and that white light is a compound of these individual colors In his treatise on optics, the first edition of which was published in 1704, Newton begins by showing that if the two halves of a card are painted red and blue, respectively, and the card is then viewed through a prism, the refracted images of the two halves will be differently displaced He then proceeds to the analysis of light from the sun, describing the experiments of his early paper but adding many others, as if he felt that the theory which he had proposed was open to question and needed all the support from experiment which could be given to it Many of the experiments are well known and are exhibited to all students of the subject, others which are not so frequently shown are of equal interest, and some of them are noticeable for their simplicity and their convincing force Newton shows that the principal cause for the failure of the telescopes of his day to give distinct images was the dispersion of the light He proves this very conclusively and then presents his plan for a reflecting telescope and describes instruments which he had made on that plan

Another set of experiments, even more elaborate than those of the first part, deals with the general phenomena of color It is shown that colors are not caused by any new modification impressed on the incident light by the material of the body, but that in every case these colors may be analyzed into the simple colors of the spectrum, and that all colors are either those of the homogeneous rays or are compounded from them In this part of the book he also explains the colors of the rainbow and of natural bodies

In Book II, we find the study of the reflections, refractions and colors of thin transparent bodies Newton describes at length the rings that are seen in the light reflected from a thin film of air confined between a sheet of plate glass and the slightly convex face of a lens He tabulates the successive colors which appear in these rings, when viewed with white light, and studies them also when the light used comes from one part of the spectrum only In this way he recognizes that there is a certain periodicity exhibited by the light and that the light seems to change its properties at certain equal short intervals of distance so as to be, in one condition, capable of easy reflection and in the other, of easy refraction These conditions he calls by the name of "fits" of easy reflection and of easy transmission They are not specified or described in any definite way and no attempt is made to present a model of the light in these fits or to describe its operation Newton does say that if any one wishes to have a scheme by which he can visualize the action, he can imagine that the rays of light, when they impinge on any surface, may set up vibrations in the refracting or reflecting medium, and that these vibrations are so transmitted as to overtake the rays, and that when a ray is in that part of the vibration which combines with its motion, it easily breaks through a refracting surface, but when it is in that part of the vibration which impedes its motion, it is easily reflected, but he says "Whether this hypothesis be true or false I do not here consider I content myself with the bare discovery that the rays of light are by some cause or other alternately disposed to be reflected or refracted for many vicissitudes"

Newton goes on to apply this theory of alternate fits to explain certain colors of thick plates which were first observed by him

In Book III, Newton gives an account of his experiments on the general subject of diffraction, starting from the original observations of Grimaldi The experiments are not very numerous or very precise They convinced him that the action of the body on light which passes near its edge extends for some little distance beyond the material of the body itself. They did not lead him otherwise to any important extension of his views Apparently his experimental activity ceased before he had carried out the experiments which he had planned in this part of the subject, and he was never able to resume the work Instead of going on with experiments, he contented himself with introducing a number of queries, in some cases suggestive of additional experiments, in others presenting hypotheses as to the nature of light and explanations of the phenomena discovered. Only a few of these queries appeared in the first edition, but their number was increased in the second edition to thirty-one. They are of great interest as showing Newton's mind when it turned to speculation. No one was more adverse to speculation in science than Newton. In the present book he reiterates the *hypotheses non fingo* of the Principia, and yet he could not keep himself entirely from hypotheses. Indeed it is difficult to see how progress can be made in such a science as optics without the help of hypothesis. Yet even in this hypothesis making, Newton's caution is evident.

He supposes that the emission of light results from the vibrations of the parts of the luminous body and that light is seen by vibrations excited in the retina of the eye. He suggests that different rays make vibrations of different bigness and that these excite colors, just as the vibrations in air make sounds of different pitch, and that the most refringent rays make the shortest vibrations. He suggests again that the rays when they fall on the refracting medium may excite waves which overtake the rays of light and thus make the alternate fits which observation discloses. By experiment he proves that heat may be transmitted through vacuum and therefore, he suggests, through a much subtiler medium than air. This medium he thinks is possibly rarer in bodies than it is outside them, and on the supposition that its density increases slightly as the distance from the body increases, he suggests that gravitation may be explained by possible pressures in this medium. He insists, however, that this medium must be of excessive rarity and that a dense medium in which waves could be transmitted, such as is suggested by Huygens, can be of no use for explaining the phenomena of nature and he goes on to say that "as it is of no use and hinders the operation of nature, and makes her languish, so there is no evidence for its existence and therefore it ought to be rejected. And if it be rejected, the hypotheses that light consists in pression or motion, propagated through such a medium, are rejected with it." Earlier in this query he rejects the wave theory on the ground that "if light consisted of pression or motion propagated either in an instant or in time, it would bend into the shadow." From the consideration of the phenomenon of polarized light as discussed by Huygens he concludes that "the rays of light have four sides or quarters, two of which opposite to one another incline the ray to be refracted after the unusual manner, and the other two do not incline it to be otherwise refracted than after the usual manner." This property he thinks is proof positive against a wave theory. In query 29, he presents his corpuscular theory of light. He points out that if the rays of light are very small bodies emitted from shining substances they will travel in straight lines and will be able to preserve their properties unchanged as they pass through various media. They may also be reflected and refracted according to the ordinary laws. To produce the various colors, he suggests that the rays of light may be bodies of different sizes and that they may be put into the fits of easy reflection and easy transmission by stirring up vibrations in the bodies on which they act "which vibrations being swifter than the rays overtake them successively, and agitate them so as by turns to increase and decrease their velocities, and thereby put them into those fits."

In the introduction Professor Whittaker has pointed out that these speculations of Newton present analogies to those which are prevalent at the present day in quantum theory and in wave mechanics. They are of great interest as showing how far an acute mind may go in the speculative interpretation of a body of phenomena without really committing itself to a definite conclusion. What Newton would have thought if he had been shown Young's demonstration of interference and Fresnel and Arago's work on polarized light we can not certainly determine, but it is an interesting subject for speculation.

The book is well printed. In two or three places the long "s" of the original has misled the typesetter into saying that certain intervals "found a common chord," but generally it is remarkably free from error. The publishers should be thanked for this timely issue of a very important book.

W. F. Magie

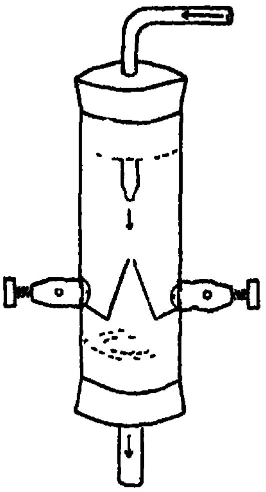
Princeton University

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ELECTRICAL DROP COUNTER

While making a study of physiological secretions, a drop flow record over an extended period of time was desired. Several different types of apparatus for this purpose were designed, but the one presented here was found to be efficient. Besides its use to record such fluids as urine, saliva, bile, pancreatic and other such secretions, it might be used wherever a record of drop flow is desired over an extended period of time, *e.g.*, slow titrations, evaporation experiments or condensation rates, etc.

A glass tube with inside diameter of about three



centimeters and about eight centimeters long was used Two holes were blown opposite each other about six centimeters from one end of the tube Through these holes were placed brass binding posts held in place by a screw from the inside Small rubber washers were used to prevent breaking the tube on tightening these binding posts. Each screw head carries a length of platinum or non-corroding wire shaped as shown These contact points are about one millimeter apart

The top of the tube is stoppered with a rubber stopper carrying the inlet tube of glass, the tip of which is shaped to deliver drops on the contact points The rubber stopper in the bottom of the tube carries a large bore glass tube funnelled to catch and drain the liquid.

In use the two binding posts are connected across one lead wire of a signal magnet The writing point of this magnet inscribes a record on a slowly moving surface If one desires to use this apparatus on such weak electrolytes as urine or tap water it is best to obtain small coil magnets from radio receivers and make special magnets for recording purposes A voltage supply suitable for such an assembly is a twenty-two and a half volt radio dry cell, although we have found line voltages of ten and twelve as used in our laboratories of sufficient strength

SEWARD E. OWEN

DEPARTMENT OF PHYSIOLOGY AND
PHARMACOLOGY,
NORTHWESTERN UNIVERSITY

PAPER APRON TO PREVENT CURLING OF MICROTOME SECTIONS

A VERY simple process, far more difficult to describe than to perform, of using a small wet paper on a paraffine or celloidin block will prevent curling.

A piece of wet tissue paper narrower than the knifeward edge of the block and longer, so it will overlap the side away from the blade, is placed on the paraffine or celloidin block. Capillarity will hold the paper in place The paper should not overlap the knifeward edge or the blade will slide over all The cut section with the paper will rest flat on the knife with the overlapped edge in such position that the paper, with section adhering, can be easily removed with forceps or scalpel and placed on a wet slide, where the section can be oriented, and the paper, with a backward bend of the overlapped edge, removed, leaving the section in place With a little practice this will become easy Though unruly sections are very infrequent it is desirable to leave a wider margin of paraffine on sections by not trimming block as close as usual This gives an area where a needle or scalpel point can be inserted to wedge off the few unruly sections that do occur. I find it desirable on a Thoma Jung to flip the paper and section into my hand with the edge of a scalpel or pair of forceps, as the edge of section adheres to edge of knife

This process works more easily with a sliding microtome than with a rotary, though it will work with either. Obviously, ribbons can not be cut in this manner, and the process is much slower, but sections, either paraffine or celloidin, are obtained uncurled. A sharp blade is just as necessary with this method. Using woody apple buds I have obtained excellent five micron sections and good three micron sections on a Thoma Jung.

I am indebted to Dr E. J. Schreiner, research forester of the Oxford Paper Co., who told me that for unembedded wood he used wet slips of paper, one to each section, to prevent curling, and later floated off the paper Because paraffine sections will not spread properly with the paper adhering, I find it necessary to remove paper before heating slide. Whether the process is new or not we do not know. Lee, "Vade Mecum," does not mention it, and we have never heard of its being used elsewhere

Let me add that for sections that tear readily, not being well embedded, I can not recommend too highly the "collodionisation" method suggested in Lee, "Vade Mecum" Merely paint surface of block with very thin celloidin, allow a second or two to dry, place on wet paper and cut. Spread with heat as usual. After drying, before placing slide in xylol, I find it desirable to remove celloidin surface by first immersing a minute in ether-alcohol.

F. A. VARRELMAN

NEW YORK BOTANICAL GARDENS, N. Y.,
AND THE AMERICAN UNIVERSITY,
WASHINGTON, D. C

SPECIAL ARTICLES

THE AGGLUTINATING ACTION OF AGAR ON BACTERIA

THE recent statement by C. P. Fitch and associates[1] that small amounts of agar have some influence on thermo-agglutination of the *Brucella abortus* group leads me to state briefly some facts in reference to the same or a similar phenomenon not associated with heat which was first observed a dozen years ago in the study of *Brucella abortus*. Though the phenomenon may be well known, the writer has not seen any reference to it until the appearance of the article cited. Examination of recent hand-books, such as the "System of Bacteriology" by English authors and the latest edition of the German hand-book by Kolle, Kraus and Uhlenhuth, has not revealed any statement bearing on this property of a universally used culture material.

The custom of having a small amount of condensation water left in the sloped agar tube brought this phenomenon to the surface. When growth from the agar surface is suspended in water, normal saline or bouillon, *Brucella abortus* exhibits active Brownian motion. When the same growth is suspended in a small drop of condensation water from the same or a sterile agar tube, the clumping is so prompt that all bacteria appear in dense cloudlike masses no matter how quickly the slide is placed under the microscope. At first the clumping was referred to specific agglutinins in animal tissues placed in the tube but soon found to be inherent in the agar itself. The clumping persists in the condensation water of a culture medium consisting of 2 per cent. agar only. Acid agglutination was eliminated, inasmuch as the clumping took place in a neutral medium. It does not occur among bacteria from the sloped agar surface itself when they are suspended in bouillon, normal saline or water.

If the original condensation water formed after the agar tubes have been sloped and then placed upright be removed and replaced by either bouillon, normal saline or water, the added fluids acquire within a few days clumping properties. A second replacement acts in the same way. Even when enough fresh fluid is added to the upright tube to cover most of the slope, the fluid acquires clumping properties. This removal and replacement was carried out four successive times by covering the agar surface each time with the fresh fluid. The water clumped after the second exhaustion completely, only partially after the third, and not after the fourth. The clumping agent is present in the water in which agar shreds are allowed to swell up. After repeated washings of the shreds over night the fluid failed to clump. Made into ordinary nutrient agar, the condensation water which formed again clumped, but the clumps were small as compared with the large cloud-like masses of the usual supply. Allowed to stand for several weeks, the agar tubes made with washed agar failed to clump. When a thin film of bouillon was allowed to rest on the entire slope, the clumping reappeared next day. Boiling and resloping brought clumping back promptly, however.

Spontaneous agglutination was first observed among members of the non-motile Brucella group and was at first regarded specific for that group. All races acted alike. Another species similarly affected is the motile paratyphoid bacillus, including many races thus far examined. A strain from the surface of an agar growth when stirred in condensation water becomes clumped, but not wholly. About one third of the rods remain single and in motion. The rest are in clumps in which the rods are ranged side by side. These bundles measure up to 10 μ in breadth. Since the bacilli in young cultures are all in active motion the clumping is not selective with reference to motility. Clumping has also been observed in certain strains of staphylococci, streptococci, *B. pullorum* and *B. bronchisepticus*. There are indications that capsulated bacteria, not clumped themselves by such capsular material, are not affected by the agar agent. The concentration of the agglutinating substance in the condensation water varies with the time of exposure of the agar mass to it. Clumping was still present in dilutions of 1 to 8 in many observations.

It would require more space than this communication is entitled to to go into further details or to try to correlate our observations with those presented by Fitch and associates. Further analysis of the phenomenon has been under way.

THEOBALD SMITH
DEPARTMENT OF ANIMAL PATHOLOGY,
THE ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH,
PRINCETON, NEW JERSEY

INTELLIGENCE AND BODY CHEMISTRY[1]

IN a recent communication to SCIENCE,[2] H. D. Powers reports a series of observations of the calcium and the inorganic phosphorus of the blood in idiots and in normal or superior persons. The writer has certain data bearing on this point to which he desires to call attention. These include material which has not previously been published because the essentially negative nature of the results indicated the need for further work.

The data presented below were obtained from a random sample of children referred to the Illinois

---

[1] *Tech. Bul.* 73, 47, Univ. Minn. Agri. Exp. Sta., 1930.

[1] Publications of the Institute for Juvenile Research, Paul L. Schroeder, M.D., Director. Series B—No. 175.

[2] H. D. Powers, SCIENCE, 73, 316, 1931.

Institute for Juvenile Research, being limited only by the technician's ability to obtain from the patient a sufficiently large sample of blood. They included intelligence levels ranging from the imbecile to the superior Calcium of the blood was determined by the Clark-Collip modification of the Kramer-Tisdale method, inorganic phosphorus by the Fiske-Subarrow method, and total and lipoid phosphorus by similar procedure following digestion and alcohol-ether extraction, respectively The intelligence quotient was obtained in each case by an individual mental test

The coefficients of correlation obtained between the I Q 's and the chemical determinations are given below, together with the number of cases upon which each is based (in parenthesis)

	Correlation with I Q
Calcium	+ 06 (69)
Inorganic Phosphorus	+ 07 (245)
Lipoid Phosphorus	- 04 (77)
Total Phosphorus	+ 06 (118)
Lipoid P ÷ Total P	+ 19 (63)

Our results agree with those of Powers with respect to the calcium of the blood. There is no evidence that it bears any relation to the individual's intelligence.

With respect to the inorganic phosphorus of the blood, on the other hand, we differ markedly from Powers. The data obtained from 245 subjects show no relationship between intelligence, as measured by the I Q, and the phosphorus content of the blood. There is, of course, a difference in method. We worked with persons *ranging from* subnormal to superior intelligence, instead of extreme groups, and did not include cases of idiocy If, however, the difference obtained in such extreme groups is valid outside of the very lowest ranges of intelligence, a correlation will necessarily be apparent when a wide range of intelligence is considered Although our subjects were children, age does not appear to be a factor, for we have found that it correlates with the inorganic phosphorus content of the blood only to the extent of - 14 Moreover, the determinations of lipoid and of total phosphorus show no higher relationships to intelligence than do those for inorganic phosphorus The ratio of lipoid phosphorus to total phosphorus does, indeed, correlate more highly with intelligence, but, as this relation is vitiated by a correlation of + 30 between this ratio and chronological age, further work with controlled age groups is essential for its interpretation.

The relationship of phosphorus metabolism to mental phenomena is a problem which is as yet far from solution We have noted elsewhere[3] a correlation of - 51 between intelligence and the excretion of phosphorus per unit of body weight. As the significance of this figure is lessened by the fact that it was obtained from only 28 subjects, it was suggested that verification was most desirable. This definitely positive result from a study of urinary excretion, the negative results mentioned above, and Powers' positive findings, taken together, suggest a complexity of relationship that urgently calls for further work. Our interest has been primarily in connection with certain non-intellectual traits, with which both the calcium and the various types of phosphorus in the blood likewise failed to show any significant correlations

In his first paragraph, Powers makes reference to the lack of previous work on the relationships of body chemistry to mental phenomena, and characterizes the work that has been done as "vague" This broad statement can not be allowed to pass unchallenged For example, the literature contains a group of studies, too numerous to mention in detail here, on the differential chemistry of the psychoses and neuroses[4] In general, the procedures have been similar to that of Powers, save that psychotics or neurotics, instead of idiots, were compared to normals. Many of these studies have yielded negative results and they have often contradicted one another, but they have hardly been "vague" Such work as that of Starr[5] and Stratton[6] on stammerers likewise reached definite conclusions, and the writer[7] has published correlational values One fears that Powers has been somewhat overhasty in drawing his indictment, for he has himself published nothing more definite than can be found elsewhere.

GILBERT J RICH

INSTITUTE FOR CHILD GUIDANCE,
NEW YORK CITY

BOOKS RECEIVED

Anales de la Direccion de Meteorologia Tomo XIX · Conteniendo las observaciones practicadas en al año 1928 Volumen I Resultados de las Observaciones Aerológicas Efectuadas con Globos Pilotos en el Observatorio Regional Buenos Aires Ministerio do Agricultura de la Nacion, Buenos Aires

Boletim do Museu Nacional Volume VI, No 2 Pp 61 + 147, No 3 Pp 149 + 264, No 4 Pp 265–320 Illustrated The Museum, Rio de Janeiro

SPEERSCHNEIDER, C I *The State of Ice in the Arctic Seas 1930* Pp 17 Danish Meteorological Institute

---

[3] G J Rich, *Jour Abnorm and Social Psychol*, 23. 172, 1928

[4] Reviews of the earlier of these papers may be found in A Schaefer, *Monatschr f Psychiat*, 2 157–162, 229–242, 377–386, 443–451, 1897, F M. Barnes, *Amer. Jour Insanity*, 68 431–472, 1912, and K M Bowman, *Amer Jour Psychiat*, 2. 379–408, 1923

[5] H E Starr, *Amer Jour Psychol.*, 33. 394–418, 1922

[6] L D Stratton, *Jour. Compar Psychol*, 4: 325–346, 1924

[7] G J. Rich, *Jour. Abnorm and Social Psychol*, 23: 158–175, 1928, *Arch Neurol. and Psychiat.*, 20: 589–594, 1928

SCIENCE

Vol 74 Friday, July 10, 1931 No 1906

The Revolt of the Biochemists Dr P A Levene 23

Clinical Investigation Dr Francis G Blake 27

Obituary
  Professor Solon I Bailey Dr Harlow Shapley
  Recent Deaths 29

Scientific Events
  The British National Physical Laboratory, The Post Graduate Medical School and Hospital and Columbia University, Dr Swasey's Gift to the Engineering Foundation, The Centenary of the Harveian Society of London 30

Scientific Notes and News 33

Discussion
  Crystalline Amylase Dr M L Caldwell, L E Booher and Professor H C Sherman *Psychic Analogues of Allergy* Professor Henry Sewall *Leaf Diagnosis and the Interpretation of Fertilizer Requirements of Plants* Professor A E Murneek and E J Gildehaus *The Mechanism of Crossing Over* Dr. Karl Sax *The Divining Rod and Fakers* Dr Warren K Moorehead *The Visit of Dr Jakob E Lange* Professor H M Fitzpatrick 37

Reports
  United States Geological Survey Unpublished Lithographic Plates of Vertebrate Fossils for Distribution Dr Henry Fairfield Osborn 43

Scientific Apparatus and Laboratory Methods
  A Simple Ultra centrifuge Dr J W Beams and A J Weed *A Method for Comparing Growth Rates by Means of a Protractor* Dr E M Harvey 44

Special Articles
  On Molecular Organization in Ameban Protoplasm Professor A A Schaeffer. *The Cause of the Columbia Basin Footrot of Winter Wheat* Roderick Sprague *The Sex Ratio among Human Stillbirths* Dr William Walter Greulich 47

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE REVOLT OF THE BIOCHEMISTS[1]

By Dr P A LEVENE

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

May I begin my remarks of this evening by acknowledging my gratitude to the men to whom I owe the great honor of having my name added to the truly illustrious names of the Willard Gibbs medalists who have preceded me I am referring to the Board of Scientific Directors of the Rockefeller Institute for having liberally supported the work of the Chemical Division and to Dr Simon Flexner for his help and encouragement, and then to those who have participated in the work of the Biochemical Division of the Rockefeller Institute, some for a longer and some for a shorter period of the twenty-seven years of the existence of the chemical laboratories

To your section of the American Chemical Society and to the committee of award, I owe a special debt of gratitude, for I accept the medal not as a personal tribute but as an expression of recognition of that branch of science to the progress of which we have devoted our energies

To-day, this branch of science is in need of encouragement Even in European countries where biochemistry has had a long and glorious record and a great tradition, it is held somewhat in disfavor today The story of the rise and fall of biochemistry in the esteem of the higher scientific hierarchies is in a way connected with the incident of the revolt of biochemistry against the concept of vital force or, as the Germans call it, "Lebenskraft" This was a revolt against restriction of the exploits of the human mind, for, modest as the domain of biochemistry may be, it had to align itself with some more universal philosophy in order that it might remain in the family of sciences

Until nearly the middle of last century, every chemist was a biochemist Chemical hierarchies did not yet exist. All natural substances whether of mineral, vegetable or animal origin were included in the scope of interest of every chemist. Chemistry was a purely descriptive science. Substances were the subjects not only of curiosity but also of affection. Theory, whatever there was of it, played a subordinate part in the life of the chemical investigator. His mental attitude was that of a collector of "rarities." Indeed, how else could one understand the reactions of a man of the type of Scheele? In a critical period of his life a position was offered to him as head of an apothecary shop in a small town, Koping, in Sweden. An inferior competitor snatched the job from him; whereupon his friends in his native land, as well as in other countries, set out to secure a more advantageous post for Scheele. Offers came from Berlin, from England and from Upsala. And what was Scheele's reply?—"I can not eat more than my appetite permits and if I can find enough bread in Koping, is there any need for me to search for it elsewhere?" The life of Scheele was truly serene. He owed comparatively little to the theoretical legacy of the past and had no obligation to the generations to come.

---

[1] Address on the occasion of the acceptance of the Willard Gibbs medal

Scheele, himself, however, made the task of the generation which followed him more difficult, for he did something which contained the seeds of a new era. In the year 1777, Bergmann wrote that organic synthesis was beyond any hope of success, but in the year 1782–1783 Scheele prepared potassium cyanide by fusion of graphite, potash and salammoniac (NH_3HCl) and thus truly was the first to prepare *synthetically* a substance containing the element carbon linked to nitrogen and thereby to accomplish the first organic synthesis. But the significance of the achievement was not recognized at the time. Indeed, Fourcroy, in his famous text-book which appeared over 20 years after Scheele's death, maintained that whereas minerals are the products of ordinary physical forces, organic substances owe their origin to a force of an entirely different category, namely, to an organic vital force. Whereas the first were common natural forces, the latter were characterized by purposiveness. This definition does not sound much different from the one advanced by the modern Neo-vitalists.

Not Fourcroy alone but all great chemists of the early part of the last century were orthodox believers in the doctrine of vital force. Thus Berzelius believed that the secret of the origin of organic compounds lay not in the elements which entered into their composition, not in the element carbon, but in the fact that they were produced by an organism, or rather by organs of a living organism, and the term "organic" was meant to emphasize their origin. In the year 1827, Berzelius was still of the belief that the organic compounds could never be synthesized in the laboratory. Yet only a year later his own student, Wöhler, accomplished the synthesis of urea. "Did this reaction mean a transformation of inorganic material into an organic substance?" was the question which he asked of his old master, Berzelius. The answer was polite but non-committal.

To us to-day, the year 1828 stands for the date of the great revolt of the biochemists against the "Lebenskraft," or the "Spiritus Vitae." In reality, the true revolt came much later. Tradition is too comfortable an armor to be cast off at the first assault. Berzelius continued to refer to the synthetic substances as "incomplete imitations of the organic products." Gerhardt, one of the most brilliant theoretical chemists of the middle of last century, in 1842 maintained that the vital and the chemical forces are of antagonistic nature, the former accomplishing the synthetic functions and the latter that of degradation. Under normal conditions of life, the two forces are balanced, after death, the chemical forces of disintegration are unchecked.

Finally, doubts crept into the minds of some of the chemists. Thus, we find Liebig was ready to make concessions to the new tendencies. He wrote, "Under the influence of a non-chemical agent (Life, Vital Force) chemical forces also function in the organism. Through the guidance of this dominant force and not independently, elements arrange themselves into chemical substances such as urea in the manner in which the intelligent will of the chemists forces them to unite outside the organism. Hence, it will be possible to prepare in the laboratory quinine, caffeine, plant pigments and dyes but not a cell, muscle fiber, or a nerve fiber." Mulder, another biochemist of lesser magnitude as a contributor, but an able thinker, writing on "Organic Forces" states that the assumption of the existence of a peculiar vital force (Lebenskraft) was not supported by experience and furthermore he defends the thesis that the organic forces of the complex substances pre-existed potentially in the elements composing them.

All these utterances, however, were peaceful philosophical speculations lacking the momentum necessary to produce a real revolt against the authority of the vital force. Finally, the revolt broke out effectively in 1860, when Berthelot wrote, "The objective of our science is to banish 'Life' from the theories of organic chemistry." The successes in organic synthesis were behind the authority and the power of this utterance.

The end of last century continued vibrating with the enthusiasm contained in the words of Berthelot. The hopes and expectations of chemists then knew no bounds. Not organic substances alone but organized living matter seemed within reach of the synthetic method. The chemist was not isolated in his hopes and expectations. Physiologist, general biologist, physicist, psychologist and metaphysician were all under the same spell of mechanistic philosophy.

The strides made by organic synthesis for a time surpassed all expectations It suffices to read the public utterances of Emil Fischer, perhaps the most daring chemical virtuoso and at the same time the most cautious man with respect to theory or prediction, in order to realize the depth of his conviction that organic synthesis would penetrate into and would reveal the mysteries of living matter, if not of Life itself Indeed, in one of our conversations, he expressed belief in the possibility of synthesizing enzymes

But as our century advanced, a change came in the general attitude of men of science Mechanistic philosophy fell into disrepute and with it biochemistry, as one of the foundation stones of mechanistic biology, lost its prestige. Vitalism again came to the front, under the name "Neovitalism" The truth is that the "Neo" philosophies divorce the inorganic forces from the organic as much as the old vitalistic philosophy had done. The monism of the mechanistic philosophy is banished and the "Lebenskraft" is reinstated

Shall this state of mind of the philosophies of our day alter the attitude of biochemistry? Shall chance, probability, indeterminism become the foundation of the philosophy of biology as they are of the philosophy of the physical world? Shall life forever remain a word without an accurate definition? The retreat is cut off for the biochemists as it was for the revolting angels of Anatole France

True, for the individual worker, there is some justification for having moments of depression. The achievements of biochemistry may seem disproportionate to the effort, when one thinks of the time it took to unravel the structure of one substance alone Uric acid was one of the first biological substances to have interested seriously the biochemist. It was discovered independently by Bergmann and by Scheele in 1776; yet only in 1898 was the knowledge of its architecture fully attained by Emil Fischer Hemoglobin has a similar history. It was in the year 1849 that a biologist saw, under the microscope, its beautiful crystals, but not until 1929 was the architecture of hemin unraveled by Hans Fischer, while the entire structure of the crystals seen by Leyden in 1849 is not yet known. Still more discouraging is the history of proteins. These substances were known since the earliest times. In 1860 the term "protein" was introduced by Mulder, who already at that time speculated on their structure. Yet how little do we know about the details of the structure of a single protein; and the number of them in nature is endless. Think of the chromatins, which are supposed to be the carriers of heredity and of reproduction! They were discovered in 1869 by a very able biochemist, Miescher, who, in his turn, was inspired by a biologist, His, and the structure of the substances is not yet known in every detail Again, it is discouraging to think of the inadequacy of our information about the structure of starch, cellulose, gums and similar substances. Even in regard to glucose, a substance of very simple composition, and a most common component of our daily diet, the knowledge of the details of its structure is not yet complete, though the substance was obtained in pure crystalline form in 1660 by Glauber

The science as a whole, however, taking stock for the period of one hundred years, will find a record of achievement which once seemed unattainable It is enough to compare the humble attitude of Liebig and Wohler with the daring of Fischer Having made the discovery that urea constituted a part of the molecule of uric acid, Liebig and Wohler concluded that uric acid is a complex of urea with a *second radicle* the nature of which in all probability would never be revealed And yet they had in their hands enough data to permit the formulation of the molecular architecture of the substance, had chemical theory been advanced to its present state And indeed, Fischer, having accomplished the task which Liebig and Wohler thought unattainable, attributed his success not to any special individual merit but to advances in theory and in the technique of organic chemistry of his day. To-day, it may be taken for granted that the discovery of the structure of every natural organic substance is only a matter of time and organization The tools for this aim are in our hands. New achievements in this direction no longer will contain the element of surprise and it is not expected that they will reveal deeper secrets of the mystery of Life than those already in our possession

Had biochemistry discovered no new ways, no new methods for attaining the aim formulated by Berthelot, namely, to banish Vital Force from chemical theory, then the "Neovitalist" might have been justified in his pessimism in spite of the past achievements of synthetic biochemistry However, biochemistry to-day has opened new avenues of approach towards its goal. If the interest of the biochemist of the past was structure, that is, the static state of the molecule, the interest of the biochemist of to-day is the functional side of the molecule It may be remarked that this approach is not entirely new, but in the past it stood in the background, whereas to-day it is the dominant concern of our branch of science True, as soon as inorganic catalysts were discovered, Berzelius advanced the idea that life phenomena are the resultant of the play of catalysts, though of a different category from that of the mineral catalysts In the present-day terminology they would be referred to as "biocatalysts" Berzelius believed that every living organism, plant or animal, contained an infinite number of these catalysts

In the days of Berzelius, of Wohler and of Liebig, the nature of the biocatalysts was as great a mystery as that of Life itself and the quest into their chemical nature held out so very little promise of success that it was tacitly forbidden To-day, the chemical nature of at least some enzymes is no longer a matter of mystery, and much unexpected information has been obtained regarding the mode of their action It is known to-day that the action previously attributed to a single agent, a single biocatalyst, is in reality the product of the combined action of a group of agents Biocatalysts, or enzymes, as they are often called, are characterized by their instability, particularly with regard to heat, and these very unstable components, playing an important part in all life phenomena, are often powerless to act in the absence of definite accessory agents which are known under different names, as coenzymes, complements, activators or kinases The chemical nature of these last substances is one of the foremost problems of to-day Many of them have been isolated and have been found to be fragments of the more complex substances, being, for example, simple peptides which are fragments of proteins, or simple nucleotides which are fragments of nucleic acids, while others have been found to be of still simpler composition These simple substances do not play the part of accessories only, but in some instances exercise a directive influence, causing one and the same enzyme to function in one of several possible directions It may suffice in this place to refer to the lipases, the fat-splitting enzymes, which were made to produce dextrorotatory or levorotatory acids depending upon the choice of inert substances added to the reaction mixture These discoveries are very significant inasmuch as eventually they may lead to a revision of our views on the great multiplicity of the biocatalysts

The mechanism of the action of the accessory substances is not the same in every instance They may activate either the enzyme or the substrate or both in order to bring about a coupling between substrate and enzyme In the cases of fermentation and animal combustion of sugar such an alteration of the substrate (sugar) is generally accepted and certain information regarding the structure of the altered fermentable sugar already is available Thus, again, new problems are created, those of the chemical differences between the stable molecules which were the concern of the older biochemists and the unstable molecules which are the concern of the newer biochemists The change in stability of certain substances can be produced now by chemical means The grape sugar molecule seems to be activated by introducing certain groups such as phosphoric acid in a definite position of the molecule The stability of the smaller fragments of the protein molecule can be lowered by attaching certain acidic groups to the peptide nitrogen and one exceptionally stable component of nucleic acids is made very labile by hydrogenating one of its parts By selecting suitable media, the chemist has learned to direct a reaction in a desired sense when two substances may interreact in several different ways And so one of the most characteristic peculiarities of living matter, the directive force, has been imitated in the laboratory It is not important that as yet this phase of our knowledge is limited The significant thing is the formulation of the problem Its solution is a matter of routine, a matter of the ordinary ingenuity of the human mind

Granting that the problem of the directive force will be solved, it may also be granted that the entire mystery of life will not be solved by this achievement Chemistry, however, is already preparing a new attack A more essential characteristic of living matter than the directive force of individual chemical reactions is the power to coordinate all chemical reactions in such a way that the organism may function as a whole for the purpose of maintaining its normal equilibrium and for the purpose of growth and reproduction This may be regarded as the integrating force of the living organism The discoveries of the last decade alone furnish proof of the simplicity of the agents acting towards this end Think of all the hormones and vitamins! Only those which as yet have not been isolated may be thought of as complex and mysterious Those obtained in pure state are most generally found to be much simpler in chemical structure than many of the ordinary tissue components and definitely simpler than certain common drugs In fact, many of them are nothing more than degradation products of common tissue constituents Thus, it seems that in the living organism the very wear and tear of the living matter makes for its restitution and for its preservation. A decade is only an infinitesimal interval in the life of mankind and without hesitation or doubt, one may predict that the nature of all hormones and vitamins and other biologically important integrating substances will eventually be discovered

Thus, step by step, one mystery of life after another is being revealed. Whether the human mind will ever attain complete and absolute knowledge of and complete mastery of life is not essential It is certain, however, that the revolt of the biochemist against the idea of a restriction to human curiosity will continue Biochemistry will continue to function as if all knowledge, even that of life, were accessible to human understanding The past has taught that the solution of one problem always opens up a new one. New discoveries in physics, in mathematics, in theoretical chemistry furnish new tools to biochemistry, new tools for the solution of old problems and for the creation of new ones So long as Life continues, the human mind will create mysteries and biochemistry will play a part in their solution

CLINICAL INVESTIGATION[1]

By Dr FRANCIS G BLAKE
YALE UNIVERSITY

THE second article of the constitution of this society begins with the sentence, "The objects of this society shall be the cultivation of clinical research by the methods of the natural sciences, the unification of science and the practice of medicine, the encouragement of scientific investigation by the practitioner, and the diffusion of a scientific spirit among its members"

One need not stop to ask, perhaps, to what extent these objects have been advanced in a material sense since the inception of this society twenty-three years ago The expansion of the clinics during this period particularly with respect to the provision of more adequate hospital wards, laboratories and equipment for clinical investigation has been phenomenal and is familiar to you all The funds for carrying on clinical research in these laboratories, though undoubtedly not keeping pace with those that have been provided for bricks and mortar, have nevertheless increased surprisingly and perhaps as fast as is wholesome in a period of rapid expansion, when the finding of men suited for research, by reason of a primary interest in the search for new knowledge and the simultaneous possession of those rare, but essential qualities of initiative and originality, is usually more difficult than the finding of material resources In spite of this difficulty, the number of those engaged in clinical research has likewise multiplied many times during this period, to such an extent, indeed, that the published products of their labors have resulted in a deluge which at times bids fair to engulf us, whether by volume or by depth, I will leave to you to decide

While these matters need not detain us, it is, perhaps, pertinent to inquire to what extent the character and direction of clinical research and the nature of the methods it employs have been advanced, or perhaps it would be better to say, have been changed during this period of expansion in material facilities and in human activity, whether in fact these more important aspects of clinical research have kept pace with the evident material progress To do so, it is obviously necessary to have a clear conception of what clinical research is or purports to be, and also just what is meant by the phrase quoted from the constitution—"by the methods of the natural sciences"

Clinical investigation, if "the unification of science and the practice of medicine" be the worthy goal that the writers of our constitution conceived it to be, should not concern itself primarily with physiology or chemistry, with physics, mathematics, or biology, nor even with the application of these subjects by the physiologist, or chemist, or physicist or biologist to the problems of clinical medicine, but primarily with the study of the phenomena of disease by clinicians thoroughly familiar with disease in all its varied aspects through intimate and constant contact with disease in the field—whether this be in the home, the office, the out-patient clinic, or the wards of the hospital should matter little, provided the contact be comprehensive enough to give a reasonably complete picture of the disease in question

Furthermore, I believe it should be kept in mind that the purpose of this study of disease should be primarily to find out about disease, largely for the fun of doing it, to discover the circumstances or conditions under which disease develops, the nature and mechanism of the disturbances of function and structure which take place during the course of disease, and the circumstances or conditions under which recovery or death occur Secondarily, this may lead, and fortunately sometimes will, to the discovery of methods of prevention, amelioration or cure, but these practical and humane purposes should, I believe, be kept in the background, if clinical investigation is not to be too soon diverted and frequently misled in following its main purpose, the elucidation of the phenomena of disease

In this connection I should like to quote a paragraph by Slesinger[2] in a recent article entitled "The Drift of the Social Sciences"

> Social science shares with medical science the necessity of having to free itself of the desire to do good and of

---

[1] Presidential address, American Society for Clinical Investigation, Atlantic City, May 4, 1931

[2] *Survey Graphic*, 19 24, 1931.

measuring its success by the amount of good accomplished The medical sciences are only recently beginning to abandon the therapeutic aim in research It is not to be wondered at, therefore, that the younger social scientists find themselves still slightly hampered by an attitude growing not out of this subject matter, but out of the personnel attracted to the field during a stage in the development of research when welfare was more important than truth

It is sometimes well to see ourselves as others see us Let us be sure of our own position in medicine before casting the first stone, as we are perhaps too prone to do, at our younger brothers struggling for a place in the field of science

Without further delay, let us now turn to a brief consideration of the meaning, for clinical investigation, of the phrase, already quoted, "by the methods of the natural sciences" At the risk of stressing the obvious, let me make it clear at once that I conceive this phrase to refer, not to the techniques or tools used, but to the methods of approach employed in the natural sciences There are, of course, two methods—on the one hand, observation, analysis and deduction, the so-called descriptive method, still held honorable by some because of its antiquity if for no other reason, on the other hand, the inductive, experimental method, held, it would appear, in higher esteem by most, perhaps because of its relative youth and vigor To show that this is so, at least among many of those who are devotees of the biological sciences, one need only quote the following from a recent paper on "The Rise of the Experimental Method" Referring to Vesalius on the structure of the human body, and Copernicus on the arrangement of the universe, works which appeared in 1543, the author[3] says, "Intellectual activity of this order had not been witnessed since the days of Aristotle, and one might add that these two books represent the last of the really great achievements of the Aristotelian method in science"

To argue concerning the relative superiority of one method over the other would appear to me to be a somewhat fruitless pastime so far as clinical research is concerned, to hold that the experimental method is necessarily superior to the observational and descriptive method is to hold a narrow and partial view Both methods are merely complementary halves of the whole, a view so well expressed by Francis Bacon in the "Advancement of Learning," when he says, "All true and fruitful natural philosophy hath a double scale or ladder, ascendent and descendent, ascending from experiments to the invention of causes, and descending from causes to the invention of new experiments, therefore I judge it most requisite that these two parts be severally considered and handled" Whether one begins by ascent of the ladder and then descends or reverses the process and begins by descent and then ascends seems to me immaterial, and should depend in each particular case upon the nature of the subject under investigation What really matters is that he goes both ways and particularly that he stops to think when he reaches the ends of the ladder, whether top or bottom. Are we too busily engaged at present in scrambling up and down the ladder, too little engaged in pausing to think at the top or at the bottom? Again, I merely ask the question and leave you to ponder over the answer

I do not propose, then, to ask to what extent experimentation is replacing observation, the inductive method, the deductive method in the field of clinical research, but rather, what is the place of each in clinical investigation To my mind at least, disease is the inductive experiment of Nature, random though it may be, which the investigator in the field of clinical medicine must observe and describe in all its particulars, if he is to develop rational hypotheses to test by experiment Furthermore, whether he uses merely his natural senses in making observations or turns to the microscope, the test-tube or the balance, appears to me to make little difference, provided he selects the tools most appropriate for the particular problem he is studying Are the labor and tools of the cabinet maker, because of their precision, superior to those of the artist? I doubt if you will think so. Observation of natural phenomena, analysis and deduction, the descent of the ladder, appears to me to be the first step in clinical investigation and will, I believe, continue and rightly, to engage our time and attention, and perhaps a considerable part of it, certainly for many years to come.

What, then, is the place of the inductive experiment, the ascent of the ladder in clinical investigation? Its value as a method of approach needs no argument to support it Its application, however, is infinitely more difficult because the subject of experiment is man On occasion it is possible, when the procedures employed are harmless or when willing and often courageous volunteers offer themselves as subjects for experimentation Otherwise, the clinical investigator must have recourse to animals to test his hypotheses, must go to the laboratory and become temporarily a pathologist or bacteriologist, a chemist or physiologist That he is increasingly able to do so is all to his credit, but when he does so let him remember that he has temporarily abdicated his position as a clinical investigator, and that if clinical investigation is to profit he must return to the more difficult problems of the clinic to test out there the hypotheses that he has in turn developed during his sojourn in the laboratory.

---

[3] Fulton, *Yale Jour Biol and Med*, 3: 299, 1931

Finally, let us turn for a brief moment to a consideration of what changes, if any, are taking place in the direction and scope of clinical research. The historical background has been presented in so masterful a way by Faber[4] that I would not have the temerity to discuss it, even if time permitted. Furthermore, I shall have to limit myself to one field—etiology. Only let me recall that shortly before the founding of this society, under the influence of the rapid advances in bacteriology in the latter part of the nineteenth century, the search for the specific causes of disease was perhaps the most dominant and fruitful activity of the time. In the intervening period it has become more and more apparent to the clinical investigator, a fact of course long recognized in physiology through the influence of Claude Bernard, that the search for specific causes, whether they be living organisms, chemical substances, deficiencies or what not, is but one aspect of a many-sided picture and that a real comprehension of the etiology of disease resides in an understanding of all the conditions or circumstances under which it develops. Here we are concerned with pathogenesis, not etiology in the conventional usage of the word; the study of the interplay of specific agents, environmental factors, and human susceptibilities. Examples are superfluous. To have discovered the tubercle bacillus, its biological characteristics and chemical constitution, does not explain tuberculosis, to have learned the environmental factors which favor its occurrence, still leaves something wanting. The characteristics, susceptibilities and reactions of the host must also be known. The interrelationships of these three factors, and perhaps others, must be studied before one can arrive at an adequate understanding of the pathogenesis of the disease, a point of view so ably illustrated by the studies of Opie[5] in this field. I have cited but one example. Numerous others will occur to you, not only in the field of infectious diseases, but also in the trend of current investigations in diseases of the heart, the blood, the endocrine glands and so on.

Not only is this principle, this attempt to understand all the factors involved and their interrelationships, found in the work of those who are interested primarily in the pathogenesis of disease, but obviously also in the studies of those who are concerned with the phenomena of already existing disease. Consequently, I will not stop to bother you with further illustrations, but will venture to close with the doubtless rash prophecy that in this change in the direction and this enlargement in the scope of clinical investigations lies the evidence that clinical medicine is rapidly approaching a maturity of thought which has characterized the other biological sciences for a longer period of time.

OBITUARY

PROFESSOR SOLON I. BAILEY

DR. SOLON IRVING BAILEY, Phillips professor, emeritus, in Harvard University, died at his summer home in Norwell, Massachusetts, on June 5. His "History and Work of the Harvard Observatory," on which he had been engaged since his retirement in 1925, was published during the week of his death. The final instalment of his "Peruvian Meteorology" is now in press. He had indeed satisfactorily rounded off an industrious and useful scientific life, but although in his seventy-seventh year, he had not yet resigned his interest in the subject of variable stars in globular clusters—a field in which his most notable scientific contributions lie. Within the past two months, with the "History" and the "Meteorology" completed, he resumed his study of the periods of variable stars in the southern globular clusters, planning to devote a year to measurement and computation.

Professor Bailey was born at Lisbon, New Hampshire, December 29, 1854. He received the degree of A.B. from Boston University in 1881, M.A. from Harvard in 1888, and Sc.D. (honorary) from San Augustin University in Arequipa, Peru, in 1923. He became a member of the staff of the Harvard Observatory in 1887, being appointed assistant professor in 1898 and Phillips professor of astronomy in 1912. He was acting director of the Harvard Observatory from 1919 to 1921. His academic distinctions include membership in the National Academy of Sciences, the American Academy of Arts and Sciences, the Astronomische Gesellschaft and the Royal Astronomical Society. He is survived by a widow, Mrs. Ruth E. Bailey, and a son, Professor Irving W. Bailey, of Harvard University.

It is difficult in a short notice to give a fair account of the important services rendered by Professor Bailey to the Harvard Observatory and to astronomy. For three decades he was E. C. Pickering's closest associate in the development of the Harvard Observatory. In two particular instances Bailey guided the work of the present director: he pointed out in 1914 the importance of using the Mount Wilson reflectors for the problems of globular star clusters, and in 1921 he assisted, in a remarkably sympathetic, selfeffacing and helpful manner, in the inauguration of a new scientific policy in an old and complex observatory He was largely responsible for the Boyden Station of the Harvard Observatory, having established the Peruvian station in 1890 and explored the possibilities of the South African plateau in 1908 and 1909

---

[4] "Nosography in Modern Internal Medicine," New York, 1923.

[5] "The Harvey Lectures," 197, 1928–29.

Professor Bailey's early work on the variable stars in globular clusters led to the similar work on the Magellanic Clouds by Miss Leavitt He devoted more than twenty years to the study of variable stars in star clusters, producing four monographs on the subject The work also involved the classification of star clusters and the study of stellar distribution within the brighter systems

Bailey was a pioneer in the photographic discovery and measurement of extra-galactic nebulae With his associates he added several thousand new systems to our catalogues, the work being based almost exclusively on the photographs made with the Bruce refractor at the southern station. Incidentally, Bailey has long had the reputation of having made the best photographs obtained with that important but somewhat rebellious instrument

When in 1922 at the age of sixty-seven Bailey returned to Arequipa to take charge of and rehabilitate the southern station, he resumed his studies of globular clusters, which had been interrupted by some years of administrative work He also turned his attention to stellar distribution and made extensive star counts on long exposure Bruce photographs covering the south galactic pole and the rich regions of the southern Milky Way This work has been much quoted in recent years

Next to his work on globular star clusters, Bailey's volume on the "History and Work of the Harvard Observatory" will be most remembered in future years His long association with the observatory made him the logical person to survey the development and the scientific problems of one of the oldest of American research institutions This new volume is divided into three parts, the first dealing with the historical background and material growth of the observatory, the second discussing briefly the numerous research problems of the past and present, and the third dealing biographically with individuals on the observatory staff In the second part he discusses the observatory's contributions to the problems of the solar system, the astronomy of position, astronomical photography, stellar photometry, spectroscopy, variable stars and novae, clusters and nebulae, and the structure and dimensions of stellar systems He approaches personal problems with kind generosity, and scientific problems, especially the newer developments, with conservatism and objectivity Such an attitude was characteristic of him in all his dealings with people and problems, it was the source of his high standing throughout the past forty-five years in the regard of the observatory staff and of the general astronomical community

HARLOW SHAPLEY

HARVARD COLLEGE OBSERVATORY

RECENT DEATHS

DR STEPHEN MOULTON BABCOCK, emeritus professor of agricultural chemistry at the University of Wisconsin, died on July 1 He was eighty-eight years old

DR GEORGE FILLMORE SWAIN, Gordon McKay professor of civil engineering at Harvard University, died suddenly on July 1 in his seventy-fourth year

PROFESSOR MYER EDWARD JAFFA, professor of nutrition emeritus in the University of California, chief of the Bureau of Food and Drugs of the California State Board of Health since 1925 and a consulting nutrition expert for the board since 1915, died on June 28 at the age of seventy-three years

DR CHARLES ALLEN PORTER, professor emeritus of clinical surgery at the Harvard Medical School and formerly surgeon-in-chief of the Massachusetts General Hospital, died on July 3 in his sixty-fifth year

DR ALBERT E STERNE, professor of nervous and mental diseases at the Indiana University School of Medicine, died on June 30 at the age of sixty-five years

JOHN EDWIN STARR, president of the Starr Engineering Company of New York, a former president of the American Society of Refrigerating Engineers, has died at the age of seventy-one years

PROFESSOR HARALD HOFFDING, who held the chair of philosophy in the University of Copenhagen from 1883 to 1915, and was distinguished for his contributions to psychology, died on July 2 He was eighty-eight years old

THE death is announced of M E Cossarat, director of the observatory at Toulouse

SCIENTIFIC EVENTS

THE BRITISH NATIONAL PHYSICAL LABORATORY

THE National Physical Laboratory at Teddington was open yesterday afternoon to visitors, and the annual function was preceded by the formal opening of the new physics building This building will eventually form three sides of a rectangle, but only the central part has so far been erected Its door was unlocked by Sir Gowland Hopkins, president of the Royal Society, and chairman of the general board of the National Physical Laboratory, with a gold key, handed to him by the architect, Mr F A Llewellyn, after speeches by Sir Richard Glazebrook, the first director of the laboratory, and Sir Joseph Thomson

Sir Joseph Thomson congratulated Sir Richard Glazebrook on this further step in the phenomenal development of the National Physical Laboratory, which owed its prosperity and progress to his wisdom, energy and insight more than to anything else The National Physical Laboratory had a great part to play in the modern applications of science to industry

The completed portion of the new physics building will house the heat and general physics section of the physics department, with part of the radiology and sound work Apparatus for the measurement of noises was on view in this building The loudness of the noise to be assessed is determined by varying the strength of a standard sound until it is either just "drowned" by the noise or judged to be equally loud It was explained that, measured on a convenient scale of loudness with zero at the threshold of hearing, sounds become painful at about 130 "degrees" above threshold, where each "degree," known as a decibel, is approximately the least change in loudness perceptible to the ear The level of conversational speech is at about 50–60 decibels above threshold Aeroplane cabin noises are at present in the region of 80–110 decibels above the threshold The lower of these levels corresponds to that of the noise in a tube train, and it is almost impossible to converse in a loudness level of 110 decibels, even by shouting In street traffic and in ordinary trains the noise ranges from 50–70 decibels above threshold, and the laboratory is assisting the Aeronautical Research Committee in its endeavor to reduce noise in aircraft cabins to such a level

One of the new exhibits in the Aerodynamics Department this year was a large steel tunnel, the equipment of which is nearly completed, in which compressed air at 25 atmospheres pressure can be circulated round an aeroplane model Tests carried out under this high pressure are directly comparable with those on a full-scale machine—in other words, the "scale effect" which exists when working with a model in a tunnel at atmospheric pressure is eliminated. When the compressed air is circulated at full pressure by an airscrew the conditions will correspond with those surrounding a full-sized aeroplane flying at 150 miles an hour In one of the older wind tunnels tests were shown in progress on a model of the Hill Pterodactyl, the new tailless aeroplane A new and neat method of rendering streamline flow visible was displayed in the same department A number of fine platinum wires, heated by an electric current, are stretched across the airflow near a model Each wire gives rise to a band of heated air, which follows the direction of the streamline passing the wire The shadows of these heated air filaments are cast on a screen and thus give a direct picture of the streamlines

THE POST-GRADUATE MEDICAL SCHOOL AND HOSPITAL AND COLUMBIA UNIVERSITY

In accordance with the agreement between the New York Post-Graduate Medical School and Hospital and Columbia University, effective on July 1, by which the former became the Post-Graduate School of Medicine of Columbia, an administrative board of post-graduate studies in medicine has been established on which will be represented members of the governing body of the university, the undergraduate medical school and the postgraduate school of medicine

Under the terms of the affiliation, this board will have general oversight and control of all post-graduate instruction in medicine offered by the university, whether at the *Medical Center*, the *Post-Graduate* Medical School or elsewhere in the city, and is constituted as follows Dean Willard C Rappleye, *chairman*, Dr Linsly R Williams, Dean Howard Lee McBain, Director James C Egbert, Dr Walter W Palmer, Dr James W Jobling, Dr Frederick Tilney, Dr Arthur F Chace, Dr Herman O Mosenthal, Dr Howard F Shattuck, Dr Edward H Hume, Dr Harry S Dunning, Dr Lewis F Frissell and Mr Frank D Fackenthal

Dr Edward H Hume has been appointed director and Dr Alan R Anderson associate director of the New York Post-Graduate Medical School

This incorporation of the New York Post-Graduate Medical School into the teaching system of Columbia University as its post-graduate school of medicine, distinct from the undergraduate school, carries into fruition, after some forty-nine years, the ambition of the seven founders of the Post-Graduate who resigned from the faculty of the New York University upon the refusal of the trustees to grant them a separate building for post-graduate instruction and, early in the year 1882, organized the present New York Post-Graduate Medical School and Hospital

Dr D B St John Roosa, first president of the institution he helped to found, in his inaugural address in November, 1882, pointed out that while temporarily undertaken in an independent institution, this type of medical education rightly belonged with other forms of professional instruction within a university, and closed with the forecast, "the time will come when this institution will be included within a great university"

DR. SWASEY'S GIFT TO THE ENGINEERING FOUNDATION

At a dinner on June 31 at University Club, New York City, given by the chairman, H Hobart Porter, of the Engineering Foundation, President John V N Dorr, of the United Engineering Trustees, Incorporated, and Mr Porter announced that Dr Ambrose Swasey, founder of the Engineering Foundation, had added $250,000 to his previous gifts, bringing their total to three quarters of a million dollars

In making this gift Dr Swasey said "For many years past, and especially since 1914, I have thought that a great service to mankind might be rendered by the stimulation of research and development work in the engineering profession, and have sought to further that end by assisting in establishing the Engineering Foundation, whose income would be available for such purposes It has been my privilege on previous occasions to assist in the endowment of this foundation, and, having a high appreciation of the very practical and helpful results that have been already achieved, and believing that the broad and well-laid plans of the foundation promise even greater service in the future, I now take great pleasure in making available to the Engineering Foundation, through United Engineering Trustees, Inc, an additional fund of $250,000 for the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind"

Mr Swasey was born at Exeter, New Hampshire, nearly eighty-five years ago He is the surviving member of the firm of Warner & Swasey, of Cleveland, Ohio, famous for the building of great telescopes, and of instruments and machine tools of precision The Engineering Foundation was founded by the national societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers in 1914 on the basis of his conception of a research instrumentality for the profession of engineering and for broad services to mankind

There were present more than thirty presidents and former presidents of national engineering societies, of the United Engineering Trustees and of the Engineering Foundation, and other nationally prominent engineers The guests were.

L H Baekeland, former president, American Institute of Chemical Engineers; H F Bain, secretary, Mining Engineers, Philip E Bliss, president, Warner and Swasey Company, H P Charlesworth, trustee, United Engineering Trustees, G H Clevenger, vice-chairman, Engineering Foundation; H. V. Coes, trustee, United Engineering Trustees, J Vipond Davies, past president, United Engineering Trustees, J V. N. Dorr, president, United Engineering Trustees, Gano Dunn, past president, Electrical Engineers and United Engineering Trustees, and first chairman, Engineering Foundation, A. S Dwight, past president, Mining Engineers, W. S. Finlay, Jr, former member, Engineering Foundation; Alfred D. Flinn, director, Engineering Foundation, Bancroft Gherardi, past president, Electrical Engineers and United Engineering Trustees, A M. Greene, Jr, past-president, Society for the Promotion of Engineering Education, O E Hovey, vice-chairman, Engineering Foundation, C T Hutchinson, former secretary, Engineering Foundation, D S Jacobus, past president, Mechanical Engineers, F B Jewett, past president, Electrical Engineers and former vice chairman of Engineering Foundation, H A Kidder, vice-president, United Engineering Trustees, G L Knight, trustee, United Engineering Trustees, H A Lardner, ex president, New York Electrical Society, W S Lee, president, Electrical Engineers, Geo A Orrok, former vice-chairman, Engineering Foundation, G H Pegram, past-president, Civil Engineers, H Hobart Porter, chairman, Engineering Foundation, W E Reed, formerly of Warner and Swasey Company, Robert Ridgway, past-president, Civil Engineers, Charles F Scott, past-president, Electrical Engineers, C E Skinner, president-elect, Electrical Engineers; J Waldo Smith, former vice-chairman, Engineering Foundation, L B Stillwell, former chairman, Engineering Foundation, and past-president, Electrical Engineers, Ambrose Swasey, founder Engineering Foundation, past-president, Mechanical Engineers, honorary member, Civil Engineers, Calvert Townley, past president, Electrical Engineers; A L Walker, former member, Engineering Foundation, Roy V Wright, president, Mechanical Engineers

THE CENTENARY OF THE HARVEIAN SOCIETY OF LONDON

According to an article in *The British Medical Journal* the celebration of the centenary of the Harveian Society of London began with a largely attended meeting at St Bartholomew's Hospital on the afternoon of June 11, presided over by the president of the society, Sir Thomas Horder Dr Raymond Crawfurd delivered the address on "The Place of Medical Societies in the Progress of Medicine," after which Sir Humphry Rolleston proposed a vote of thanks Sir Thomas Horder then presented medals, specially struck for the centenary to Dr. D. Elliot Dickson, representing the Harveian Society of Edinburgh, and to Dr. W. H. Welch, professor of the history of medicine at the Johns Hopkins University, representing the Harveian Society of New York.

Dr. Dickson, in returning thanks, said that he was proud to represent the Edinburgh society, and also proud as a Scotsman to have heard Dr. Crawfurd's reference to the Royal Medical Society of Edinburgh Professor Welch said that all members of the New York Society would heartily appreciate the generous words in which Dr. Crawfurd had referred to its activities The principal function of that society was in its lectureships, perhaps six or eight lectures being delivered during the year in the general field of scientific medicine, and it was obvious that there was no name in history which could be more appropriately used as the sponsor of such a society than that of William Harvey Dr. Welch handed to the president an illuminated scroll on behalf of the New York Harveian Society, inscribed with cordial greetings on the occasion of the hundredth anniversary, and expressing appreciation of the significance of continuous corporate existence for so long a period: "An achievement so signal bears witness to the serviceableness to its members of any association In medicine it bears evidence furthermore, to the success of its function in the maintenance of a high standard of scholarship and its usefulness in the dissemination of learning"

The society's centenary dinner was given by Mr George Buckston Browne in the Hall of the Grocers Company of the City of London. After the loyal toasts, the president welcomed Prince Arthur of Connaught as a newly admitted honorary member of the society, and presented to him a commemorative bronze medal. His Royal Highness then proposed the toast of "Prosperity to the Harveian Society of London" He felt it a great—though perhaps an "irregular"—honor to be admitted to membership of the society, in company with Professor Welch, the doyen of the medical profession of the United States The health of the visitors was proposed by Sir StClair Thomson. This feast, he said, gave an opportunity for the mingling of men of different occupations, as well as of men working in different branches of the same profession Harvey, a man of wide humanity and culture, would have welcomed this occasion, for had he not exhorted his brethren to "dwell together in loving friendship"? Professor Welch, *The British Medical Journal* says, made in response a charming and spirited speech of appreciation for the way in which "such things are done in London" He regarded centenary celebrations as very valuable and interesting things, which appealed to him particularly as contributions to the history of medicine Lord Dawson, who also replied, spoke of Professor Welch as a citizen of the world, exemplifying the unity of purpose of the English-speaking medical profession He himself, during his visit to Canada and the United States last year to attend the annual meeting of the British Medical Association in Winnipeg, had observed the inexhaustible energy and enthusiasm of their octogenarian guest On behalf of the Royal College of Physicians, with its long and intimate associations with Harvey, Lord Dawson congratulated the society on attaining its hundredth year

The final event of the celebrations took the form of a pilgrimage to the tomb of William Harvey at Hempstead Church in Essex, near Saffron Walden A party of about sixty, headed by Sir Thomas Horder, Sir D'Arcy Power, Sir StClair Thomson, Dr Herbert Spencer and Professor Welch, journeyed by road from London on the morning of June 13 At Hempstead Church a brief service was held, and the Bishop of Colchester gave an address.

SCIENTIFIC NOTES AND NEWS

The doctorate of science was conferred on June 15 by the University of Rochester on Dr Harvey Cushing, Moseley professor of surgery at the Harvard Medical School and surgeon-in-chief at the Peter Bent Brigham Hospital.

At the commencement exercises of Purdue University, the honorary degree of doctor of science was conferred on Dr. J. C. Arthur, professor emeritus of botany, on Dr. Stanley Coulter, professor emeritus of biology, and on Professor H. A. Huston, consulting agricultural chemist, Kew Gardens, New York, who was connected with Purdue from 1884 to 1903, the last year as director of the Agricultural Experiment Station.

The University of Michigan conferred at commencement the degree of doctor of science on Dr. Warren Plimpton Lombard, for thirty-one years professor of physiology in the university medical school, professor emeritus since 1923 The doctorate of engineering was given to Clarence E Grosbeck, of the class of 1898, prominent in public utilities, and on William Aiken Starrett, of the class of 1897, designer and builder of the Empire State Building in New York City.

Mr. A C Fieldner, chief engineer of the Experiment Stations Division, United States Bureau of Mines, Washington, D C, was awarded the Lamme Meritorious Achievement Medal by the Ohio State University on June 8 This gold medal is awarded annually to a graduate of one of the departments of the university for meritorious achievement in engineering or the technical arts

The Monaco prize of 100,000 francs, established by Prince Albert of Monaco and awarded every two years by the Paris Academy of Medicine to aid some French scientific man in his researches, has been given to M Veillon, of the Pasteur Institute, in recognition of his work in bacteriology

Dr L J Cole, professor of genetics at the University of Wisconsin, was recently elected a corresponding member of the Czechoslovak Academy of Agriculture

A dinner in honor of Dr Alexander G McAdie, who has retired as A Lawrence Rotch professor of meteorology at Harvard University and as director of the Blue Hill Observatory, was given recently by the members of the Harvard Overseers' Committee appointed to visit the observatory

A portrait of Dr John M Fisher, associate professor of gynecology at Jefferson Medical College, Philadelphia, and oldest ex-intern of Jefferson Hospital, was presented to the college on June 3 It was the gift of the alumni of the college Dr Frank C Hammond made the presentation, and Dr Ross V Patterson, dean of the college, accepted it

Mr J D Figgins completes his twenty-first year as director of the Colorado Museum of Natural History on July 15 Mr Charles H Hanington, president, and Mr Walter C Mead, vice-president, on behalf of the board of trustees, have expressed their appreciation for his long service and faithful work in building up the museum They say. "Coming to us from the American Museum, New York City, when we were a new institution, it was through his untiring efforts that we have grown into an organization of nation-wide interest"

Officers of the American Society of Clinical Pathology have been elected as follows Dr W M Simpson, director of clinical laboratories, Miami Valley General Hospital, Dayton, Ohio, *President-elect,* Dr C J Bucher, department of pathology, Jefferson Medical College, Philadelphia, Pennsylvania, *Vice-president* The following were elected as new members of the executive committee Dr K M Lynch (retiring president), professor of pathology, Medical School of the State of South Carolina, Charleston, Dr A G Foord, Pasadena Hospital, Calif The Ward Burdick award was made to Dr W G Exton.

Dr James R Cash, since 1924 professor of pathology at the Peiping Union Medical College, China, has been appointed to the Walter Reed professorship of pathology at the University of Virginia, succeeding the late Dr Harry T Marshall as the second incumbent of the chair

Professor G H Hardy, Savilian professor of geometry at the University of Oxford, has been elected to the Sadleirian professorship of pure mathematics, in succession to Professor E W Hobson, who has resigned.

The General Board of the University of Cambridge was authorized on June 12 to reappoint Sir Horace Lamb, of Trinity College, to the Rayleigh lectureship in mathematics in the faculty of mathematics, without stipend, so long as he shall desire to hold that office

Dr T Thomson Flynn has been appointed to the chair of zoology in the University of Belfast Dr Flynn is a doctor of science of the University of Sydney, and is at present Ralston professor of biology in the University of Tasmania

Dr Fritz von Wettstein, of the University of Gottingen, has been called to Munich

Dr Cesari Frugoni, for nine years professor of special medical pathology at Florence, has been appointed professor of clinical medicine at Rome

At the recent annual meeting of the board of trustees of the Tropical Plant Research Foundation, Dr William Crocker, director of the Boyce Thompson Institute of Yonkers, New York, was elected acting director and general manager of the foundation It was decided to move the offices to Yonkers during a temporary period Until further notice all mail to the foundation should be addressed to 1086 North Broadway, Yonkers, New York

The U S Department of Agriculture has announced the following appointments to its research staff Dr Edward Maris Harvey, formerly professor of horticultural research at the Oregon State Agricultural College, physiologist in the division of horticultural crops and diseases of the Bureau of Plant Industry, stationed at Pomona, California; Dr Fisk Gerhardt, formerly assistant chemist at the Iowa Agricultural Experiment Station, physiologist, stationed at Wenatchee, Washington, Mr Henry Hartman, formerly professor of pomology at the Oregon State Agricultural College, horticulturist in the Division of Horticultural Crops and Diseases of the bureau, stationed at Wenatchee, Washington

Mr R W Harned, of the State Plant Board of Mississippi, has been appointed leader of the division of cotton insect investigations of the Bureau of Entomology to fill the vacancy caused by the resignation of Mr B R Coad

At the recent annual meeting of the American Association of Cereal Chemists at Louisville, Dr D A. Coleman, marketing specialist of the Bureau of Agricultural Economics of the U S Department of Agriculture, was made editor of *Cereal Chemistry,* the official organ of the association.

We learn from the *Journal* of the American Medical Association that Dr Edward N. Brush, associate editor of the *American Journal of Psychiatry* for many years and editor since 1904, presented his resignation during the annual meeting of the American Psychiatric Association on June 4, in Toronto His successor, Dr Clarence B Farrar, formerly of Baltimore and now of Toronto, was introduced at a dinner for Dr Brush, when an illuminated parchment and a purse of $1,200 were presented to him

DR RALPH H CHENEY, professor of biology, Long Island University, has been made resident investigator (economic plants) at the Brooklyn Botanic Garden beginning on July 1 The Botanic Garden has recently entered into an agreement with Long Island University for cooperation with the university's department of biology Courses given at the Botanic Garden which conform to academic standards approved by Long Island University will be accepted by the university for undergraduate credit As the university has not yet established a graduate school, it does not confer credits leading toward a graduate degree The professor of botany of the university will act in an advisory capacity to the Botanic Garden whenever called upon to do so

MR M J SEAVY has been elected president of the Palo Company Mr Seavy has been connected with the company for fifteen years and has been vice-president and manager for the last eight years It is planned to enlarge the facilities of the company for furnishing laboratory supplies

THE National Research Council will be represented at the meeting of the General Assembly of the International Research Council in Brussels on July 11 by three delegates Dr John C Merriam, president of the Carnegie Institution of Washington, D C, Dr A E Kennelly, professor of electrical engineering, emeritus, Harvard University, and Dr Frank Schlesinger, professor of astronomy and director of the Observatory of Yale University Dr Schlesinger was a member of the committee of fifteen appointed two years ago by the International Research Council to draft a revision of the statutes of the council

DESIGNATION of American delegates to the sixth International Congress on Industrial Accidents and Diseases, to be held at Geneva from August 3 to 8, under the auspices of the Swiss Federal Council, has been approved by President Hoover The American delegation includes· Dr Francis D Patterson, of Philadelphia, chief surgeon of the Pennsylvania Railroad, specialist in industrial hygiene, Dr Fred H Albee, professor of orthopedic surgery in the College of Physicians and Surgeons of Columbia University, Dr Francis D Donoghue, of Boston, medical adviser of the Department of Industrial Accidents of the State of Massachusetts, Dr Emery R Hayhurst, professor of hygiene in the College of Medicine of the Ohio State University, and Dr Emma F. Ward, of Baltimore, research investigator attached to the office of industrial hygiene and sanitation in the United State Public Health Service

DR CHARLES J FISH, director of the Buffalo Museum of Science, has accepted charge of an international survey to determine the effect on the herring industry of the proposed power dam at Passamaquoddy Bay, Maine Dr Fish has received a leave of absence from the board of managers of the museum and will go on July 10 to the Canadian biological laboratory at St Andrews, N B, the seat of the two-year investigation Other members of the commission are Dr A G Huntsman, director of the Atlantic Biological Station, Canada, O E Sette, in charge of North Atlantic investigations for the U S Bureau of Fisheries, W A Found, deputy minister of fisheries, Canada, and Dr H B Bigelow, director of the Woods Hole Oceanographic Institution Dr Fish will be executive secretary of the commission and will have charge of the work in the field

DR FRANCIS R FRASER has accepted an invitation to give the third series of the Abraham Flexner Lectures during the year 1932–1933 at Vanderbilt University Dr Fraser is director of the medical clinic and professor of medicine in the St Bartholomew's Medical School and Hospital in London He is a graduate in medicine of the University of Edinburgh, and spent some years in New York City at the Rockefeller Institute and the Presbyterian Hospital Dr Fraser recently filled an appointment as a special representative from England to confer with the medical faculties of Australia. While there he gave lectures and conducted clinics

THE American Phytopathological Society will hold its third annual summer tour and conference from July 28 to 31, under the immediate direction of Drs H W Anderson, Leslie Pierce, M W Gardner and C T Gregory For those not driving cars will be furnished Dr H W Anderson, Illinois Agricultural Experiment Station, Urbana, should be addressed for further particulars and arrangements

THE ninety-ninth annual meeting of the British Medical Association will be held at Eastbourne, from July 21 to 24, under the presidency of Dr William G. Willoughby, Eastbourne

WE learn from the *Harvard Alumni Bulletin* that the late Carroll Everett Edson, '88, A M and M D '92, just before his death prepared a will leaving the remainder of his residuary estate, after the death of certain life tenants and annuitants, to Harvard College for research in climatology, expressing the hope that the fund might be used for the establishment of a professorship under the name of the Edson Professorship of Climatology As a sudden stroke prevented the execution of this will, his sisters have executed an indenture of trust to carry out their brother's purpose

THE *Journal* of the American Medical Association reports that the Leonard Wood Memorial Committee has completed its goal of a $2,000,000 endowment for the eradication of leprosy The campaign was started in 1927 on the appeal of the late General Wood, then Governor-General of the Philippines, and was carried on after his death as a memorial to him The actual amount received was $2,031,000, contributions being received from 50,000 persons

AN Associated Press dispatch reports that the California State Park Commission has announced the successful completion of negotiations for purchase of additional forest lands for the park system with receipt of a check for $1,000,000 from Mr John D Rockefeller Ten thousand acres of redwoods will be added to state parks The campaign was sponsored over a ten-year period by the Save-the-Redwoods League, of which Dr John C Merriam, president of the Carnegie Institution of Washington, is the head Mr Rockefeller not only gave a million dollars unconditionally but pledged a second million to match private gifts as received The sum to be matched had reached between $600,000 and $700,000

THE *Harvard Alumni Bulletin* reports that the largest telescope in the eastern part of the country, a 60-inch reflector, has been secured by the Harvard Observatory and will be placed in eastern Massachusetts at a site not yet chosen, probably within 25 miles of Boston The new telescope will be of the reflector type, similar in size and general structural features to the 60-inch telescope now being installed at the southern station of the Harvard Observatory in Bloemfontein, South Africa Accessory equipment will include apparatus for the study of spectra and light variations of the stars, their temperatures, dimensions and motions The Harvard Observatory equipment has heretofore been specially suited to covering fields of a large number of stars, the new 60-inch reflector will specialize in the closer analyses of individual stars and planets

SIXTY geologists from various parts of Pennsylvania met at the Pennsylvania State College from May 29 to 31 for the purpose of studying the geology of Central Pennsylvania The Paleozoic stratigraphic section from the Cambrian to the Pennsylvanian and the geologic structure of the region were observed on a field trip from Gallitzen to Altoona and Tyrone The Oriskany gas horizon was also studied along its outcrop and a visit was made to the Bell Mine of the American Lime and Stone Company at Bellefonte Optional trips were also scheduled to the various caves of the region. At an evening meeting it was decided to form a permanent organization for the purpose of conducting similar trips in other parts of the state. The following committee on organization was appointed: Dr B L Miller, Lehigh University, Mr R. W Clark, of the Gulf Companies, and Dr. C A. Bonine, Pennsylvania State College, *chairman*. The next conference will be held in the Lehigh Valley region under the direction of the Lehigh University and Lafayette College departments of geology

SCIENCE SERVICE reports that a party of sixteen University of Chicago students under the supervision of Dr Fay-Cooper Cole has begun excavation at Indian mounds near Lewistown, Illinois, in the hope of discovering information about the oldest known inhabitants of the region These most ancient inhabitants have been named the "black sand" people The name was given them because nine skeletons were found buried in black glacial sand beneath Indian mounds last summer This year the expedition hopes to recover implements and ornaments which will shed light on the home life and customs of the tribe. The black sand Indians are estimated to have lived at least 2,000 years ago. Pointing out that the search for early inhabitants of the Mississippi Valley is highly important in solving problems of American prehistory, Dr Cole stated that Fulton County, where the excavations are being made, contains "the most complete data for culture sequence yet found in the Mississippi Valley"

FORTY-SEVEN states and territories are now extending financial support to state forestry, most of them having state foresters and participating in fire control, extension, reforestation or other related activities, according to the Forest Service. State forestry appropriations for the last year reached a total of $7,297,935. Of this amount, $2,555,329 was appropriated for fire protection by 38 states in cooperation with private landowners and the Federal Government. A total of $1,106,711 was used by 40 states for growing tree-planting stock and for reforestation. More than $2,308,000 was appropriated for purchase, maintenance and improvement of state forest lands Other appropriations were used to fight pests and tree diseases, and for education, research and extension work. In addition, large private expenditures were made in forestry activities in most of these states. State appropriations for the last two years showed a gain of more than $2,000,000 a year over similar forestry appropriations for 1927 and 1928. Cooperation between the Forest Service and the states was enlarged during the past year. The

Federal Government contributed more than $1,400,000 for protection and reforestation in cooperating states. Cooperative fire protection was extended to several million acres which had not previously been covered. The work of growing and distributing trees for forest planting also was enlarged.

DISCUSSION

CRYSTALLINE AMYLASE

NORTHRUP and Kunitz's recent announcement, in these columns, of the crystallization of trypsin, the pancreatic protease, prompts us to record here the crystallization of pancreatic amylase also

From buffered alcohol-water solutions of pancreatic amylase, freshly purified by methods previously described from this laboratory, crystals have been obtained which show enzymic activity almost as high as the maximum observed in the highly purified preparations of this enzyme as previously prepared and studied.

The crystalline amylase is obtained as very minute isotropic elongated crystals which exhibit slight double refraction. Professor P F. Kerr, of our department of mineralogy, to whom we are indebted for the crystallographic examination, reports further that the index of refraction as determined by immersion is approximately 1 54.

In view of the protein or protein-like nature of the crystals and their very slow deposition from the alcoholic systems, it is exceedingly important to work with a very small temperature gradient and in the region of hydrogen-ion activity corresponding to the isoelectric point

The hydrogen-ion activity of the solution is adjusted by means of phosphate buffers in such concentration that they are not separated out at the temperatures employed. Both formation and yield of crystals are very dependent upon the hydrogen-ion activity of the system.

Careful study and rigorous observance of the best experimental conditions thus far found make it possible to obtain crystals with regularity, but as yet only in very small amounts Furthermore, the crystals are so minute, so light and so unstable that even after they have been formed they must be handled by means of highly specialized and very time-consuming technique.

Hence it appears inevitable that further progress must be exceedingly slow and it therefore seems best to record, at this preliminary stage of the work, the fact that this much-studied and presumably typical amylolytic enzyme has been obtained in crystalline form, even if as yet only upon a small scale [1]

M. L. CALDWELL
L. E BOOHER
H C SHERMAN

PSYCHIC ANALOGUES OF ALLERGY

WHEN a foreign protein comes in contact with the tissue cells of a normal organism these become irritated and enter upon a cycle of unwonted metabolic change, the results of which appear in a week or two

The first of these results is a specific hypersensitiveness toward the foreign protein in question so that thereafter infinitesimal quantities of the latter may be able to irritate the cells

Experiment has made it obvious that the acquirement of specific sensitization goes hand in hand with the development of extraordinary powers within the tissue cells for rapid destruction, digestion or neutralization of the offensive foreign protein The effective cellular agents in these reactions we know as *antibodies* Their varieties and qualifications transcend our knowledge

While the details of these cellular evolutions are exceedingly complex it is manifest that they are all coordinated to effect a purpose, to protect the body against a foreign poison, to endow it with what we call immunity toward the harmful substance which first irritated the cells

Study of the pathogenesis of various infections leads irresistibly to the conclusion that, by and large, the essence of all infectious diseases inheres in the foreign proteins liberated in the body through the presence of invading microbes Obviously no range of human endeavor is more fraught with problems affecting human welfare than that which is concerned with the understanding and control of the poisons leading to immunity.

There are doubtless several ways by which the biological status of immunity may be attained, but only one concerns us here—that, namely, in which the foreign protein or "antigen," as it is called, on entering the normal body has been able in the course of a few days to excite the latter to develop essentially new vital powers objectively witnessed by specific hypersensitiveness and defensive antibody reactions The normal body which has undergone such a course of cellular training is now said to be "immune" toward that particular antigen, or microbe, which started the disturbance. It is characteristic of the immune state that the body which has acquired it responds at once with defensive reactions calculated to inhibit or destroy the irritating antigen whenever thereafter the latter makes a new invasion

It might safely be predicted that all future contests between the assaulted organism and the intruding pathogens must be determined on a merely quantitative basis according to the number and virulence of the latter

---

[1] Contribution No 661 from the Department of Chemistry, Columbia University, New York.

When these factors are small enough the prepared defenders of the body destroy the invaders without perturbation, and gain strength by the exercise, the conscious mind is oblivious of the danger which had threatened its citadel

But in actual experience or at the will of the experimentalist the number and virulence of the intruding microbes may surpass the abilities of the prepared mechanisms of defense For the invaded host the contest then concerns, as it were, not the occasional criminal helpless before the bar of justice, but a national enemy threatening subjugation of a whole people The result can only be determined by a war In vital statistics this war is classified as "disease", for the experimentalist its activities are broadly expressed by the word "allergy" Allergy implies a defensive reaction against a particular antigen in a prepared subject The energy of the conflict is a function of the parity and the powers of the contenders A decisive ending may signify the victory of either contestant It may be assumed that in the scheme of Nature there is a definite purpose behind all these cellular changes in an animal which follow its infection with pathogenic microbes and culminate after some days in an allergic state capable of explosive physiological reactions under the stimulus of reinfection Indeed, as will be indicated in a contribution as yet unpublished, the manifestation of allergy is not saved up like gifts for Christmas, ready for a grand celebration when a set time is reached, on the contrary, there is reason to believe that allergy, which includes specific hypersensitiveness and altered reaction, is initiated in the tissue cells at their earliest intercourse with invading germs. Nevertheless we can not admit that the ultimate purpose of nature is merely to develop in protoplasm a capacity for explosive disintegration Rather her aim is peace—to be achieved by war only when necessary And peace is complete immunity

Nevertheless, the establishment of acquired immunity, either through the accident of disease or the intention of experiment, is commonly bound up with the inflammatory reactions of allergy which, like a club in the hands of a blind ally, may strike friend or foe alike

The protection of the host through the tissue and functional reactions of allergy is so constant a concomitant of reinfection, or as the French prefer to say, super-infection, that a majority of the leaders in immunology assume that the sword of accomplishment in the establishment of immunity is allergy itself, or that allergy is the indispensable directive force of reactions through which immunity is established

Calmette,[1] himself a proponent of this view, squarely states the paradox that the same allergic reaction in the host which under favorable conditions holds in check or forthwith destroys the microbic enemies of reinfection may, when the cellular responsiveness is enfeebled, turn upon its master and hasten his dissolution

The distinguished American spokesman for the same point of view, Allen K Krause,[2] closes a series of brilliant experimental researches aimed at the identification of allergy as the essential and effective agent of immunity, with the frank confession that, in spite of all demonstrated probabilities in favor of his theme, there still lacks convincing proof that his thesis is sound

Now come Rich and McCordock[3] who, in a bold and most instructive essay, flatly deny that allergy is the essential basis of immunity According to them the evidence of facts is decidedly against rather than in favor of such a view While admitting that allergic reaction may at times favor protection of the host, such a relation is casual and not essential The nub of their argument consists in the known lack of parallelism between the intensities of allergy and immunity Either may be conspicuously weak while the other is correspondingly strong

The whole argument seems to have reached a stalemate The fast accumulating wealth of immunological facts finds no general law for their classification There lacks a shibboleth—touchstone of fealty as between cell and microbe

It has occurred to the writer that our philosophy of biological reaction may need a new point of view, less narrowly mechanistic than we can expect from our laboratories of to-day

No physical proofs can be offered, only suggestive analogies from the psychic phase of that life of which, it is commonly agreed, allergy and immunity represent quasi-functions of the soma.

Consider pain How negligible in health and wellbeing! Yet were there no such sensation it is safe to predict that animal life would not long persist Consider fear, the warning forerunner of impending evil, the advocate of protective preparation How universal and all-controlling this emotion and that sensation. These two incidentals of the psychic life would be monstrously out of place in a trouble-free Eden, in our fool-a-day world they unite to make the cornerstone of human activities

---

[1] A Calmette, "L'Infection bacillaire de la Tuberculose chez l'homme et chez les animaux," 1920

[2] A K Krause, and Krause with Willis or Peters, Numerous contributions to the *Amer Rev of Tuberculosis*

[3] A R Rich and H C McCordock, *Bull.* Johns Hopkins Hospital, xliv, 273, 1929

Using words of broad signification, we may assume that through fear the mind keys the body to instant defensive response for mutual protection But there was not always a mind It is a late sublimation of protoplasmic function

But it is inconceivable that communities of living cells should have failed in the essentials of defensive reaction while waiting the development of a psychological organ The elaboration of a technique of immunity must have kept pace step by step with the lethal powers of poisonous foes, else sooner or later must the defenseless race have succumbed It seems probable that this technique accomplishes its purpose of immunity through two different methods

The immigration of limited numbers of aliens into a growing country adds power to the population when they become assimilated without confusion What we call "natural immunity" may find its analogue in some such process But a common historical event has been a mass invasion of one people by another where the issue is not fusion, but conquest of one by the other In such a case the national spirit of the invaded people is aroused to mobilize their mechanisms of defense, and these may or may not be adequate for victory

But there is no likeness whatever between the national spirit and the military operations which it called into being They have different rôles in the warfare They may combine in a powerful union or, isolated, each may hurry to self-destruction

The national spirit senses constantly the state of the country in its relations with alien peoples, always with a view of future possible conflict Defense mechanisms of many kinds, each adjusted to deal with incipient trouble, are trained to go automatically into action It may be plausibly maintained that this awareness of the country's interests, which is an attitude of the national spirit, finds an analogue in what is termed "allergy" in the phenomena of animal reinfections

Allergy is the excitement-energy which precipitates the activities of prepared mechanisms of various kinds, here with violent inflammation and high fever, there with the gentle solution and disintegration of foreign germs and poisons without trace Its whole import and reason for existence is protection of the organism—immunity The more perfect and powerful that immunity, the less noise of conflict, the less evidence of allergy But when the strongholds of the defenders are carried by assault—then allergic agony is futile to protect

These analogues do not in themselves form admissible evidence, but they may broaden that field of suggestion from which the clews to most lines of productive research are picked

No propaganda for the generation of public opinion can compare in speed and effectiveness with that universal hypersensitiveness to its own products which the growth of tubercle bacilli in a remote corner of the body has for the whole animal organism

Physicists now soberly tell us that in the last analysis matter and energy are but different phases of the same something Perhaps disputing biologists may come to see in vitalism and mechanism complementary views of the same subject

As pain, fear and national spirit may be regarded teleologically as stimuli to conservative defensive reactions on the part of living units or communities, so perhaps we may properly consider allergy to represent a kindred agency which both generates hypersensitiveness to noxious inclusions and stimulates the body cells to form and operate defensive mechanisms against them According to this view, in the language of social life, allergy is *in* immunity, but not *of* it

Henry Sewall
University of Colorado

LEAF DIAGNOSIS AND THE INTERPRETATION OF FERTILIZER REQUIREMENTS OF PLANTS

With an enthusiasm and tenacity that is reminiscent of Pasteur, H Lagatu and L Maume, of l'Ecole Nationale d'Agriculture de Montpellier, have made numerous investigations during the past ten years and published *in extenso* on this subject[1] Recently some of this literature has been widely distributed among the agricultural experiment stations in the United States and elsewhere and has found partial recognition in this country[2][3]

The main principles enunciated by the authors are that when one of the major elements—nitrogen, phosphorus or potassium—is omitted from a fertilizer the other two will be absorbed proportionally more, thus leading to unbalanced nutrition, disturbed metabolism and reduced yield These conclusions are contrary to the widely accepted and amply verified "Law of the Minimum" (Liebig) as applied to nutrition of plants Experimental data from which these deductions are drawn have been secured by the above authors, largely from the grape, *Vitis vinifera,* and more recently from the potato, *Solanum tuberosum,* the plants having been subjected to various régimes of nutrition. These records are primarily in the form of chemical analyses of leaves for N, K_2O, P_2O_5 and CaO

---

[1] *Compt Rend Acad Sci*, 179 782, 932, 1924, 180 1179, 1925, 182 653, 1926, 184 229, 1927, 188 1062, 1929, 190 389, 1137, 1516, 1930, 191 579, 1930 *Compt Rend Acad Agr*, 13 437, 548, 1927, and 14 762, 1928 "Le diagnostic foliaire de la pomme de terre," *Ann Sci Agron*, 47 5 596, 1930

[2] Science, 70 382, 1929

[3] Science, 72. 425, 1930

In the extensive literature on plant nutrition, one finds frequent references to the general appearance of the plant, particularly its foliage, as being symptomatic of the deficiency of certain major or minor nutrient elements In fact, Russell[4] gives a comprehensive list, which shows the apparent relationships between leaf appearance and lack of particular nutrient elements, but cautions that "if they (symptoms) are to be used in any but a general way, they should be studied by setting up the appropriate vegetative experiments" in order to verify the relationship between a particular symptom and its probable antecedent cause Few[5] investigators, however, have gone so far as to base on chemical analysis of leaves either a diagnosis of the state of nutrition or to suggest or prescribe a program of soil fertilization To the writers' knowledge leaf diagnosis (*diagnostic foliaire*), as conducted by Lagatu and Maume, is the first serious attempt in this direction Is this method and technique really applicable in studies of nutrient requirements of plants, especially perennials? A partial confirmation comes from Wallace,[6] who found that the omission of potassium from a "complete fertilizer" applied to soil resulted in an increased absorption by *Ribes grossularia* of nitrogen and phosphorus But when either nitrogen or phosphorus was omitted from the fertilizer then there was a decreased absorption of the other two elements

The present writers had an excellent opportunity to test the principles proclaimed by Lagatu and Maume during the course of study of the physiology and metabolism of the apple (*Pyrus malus*) Dwarf trees were grown in pure quartz sand cultures and were supplied with nutrient solutions containing a constant and optimal concentration of phosphorus, nitrogen and potassium For two groups of plants, however, the concentration of N and K in the nutrient solution varied respectively from 0 to 323 and 368 parts per million (ppm) At appropriate periods leaves and twigs were subjected to a chemical analysis for total N and K

It is quite evident that the reduction or total omission of either nitrogen or potassium in no instance resulted in an increased potassium, respectively nitrogen content of leaves. Quite the contrary; with a decrease of nitrogen in the nutrient medium there was a decrease in potassium concentration in the leaves and with a decrease in potassium there was a decrease in nitrogen Moreover, the relative concentration of N and K in twigs was exactly of the same order, but, of course, of a different magnitude (More detailed data on the chemical composition of leaves and twigs of these trees will be published elsewhere)

Analysis of Leaves of Pyrus malus

Nutrition		Chemical composition	
K and P	N, ppm	Total N, per cent.	Total K, per cent.
Constant	0	1.62	0.89
Constant	110	1.45	1.10
Constant	323	1.73	1.49
P and N	K		
Constant	0	1.38	0.94
Constant	126	1.45	1.10
Constant	368	1.50	3.04

These experiments furnish a concrete evidence and corroborate the negative results secured by Wallace and by Thomas[8] with the additional proof that, contrary to Wallace, the omission of potassium did not increase but evidently decreased the absorption of nitrogen Consequently the principles proposed by Lagatu and Maume have not been verified, and Liebig's Law of the Minimum, as amplified by Mitscherlich[7] and others, must be considered as our best guide in the nutrition of plants.

But, disconsidering their codified generalization, why have Lagatu and Maume obtained seemingly consistent results with the grape? A part of this discrepancy between our and their results most probably is due to the fact that each species (in these instances *Vitis vs Pyrus*) absorbs soil nutrients in a "physiologically balanced" proportion. Hence we have to deal here with selective or differential absorption, ionic antagonism and related phenomena (Loeb, Osterhout) as is suggested by Thomas.[8] Thus one is referred to the soil, more properly to the soil nutrient solution, and to the specific régime of fertilization of their plants as the primary causal source of Lagatu and Maume's results and Mitscherlich's[7] method of interpretation should be applied.

It seems to the writers that other equally, if not more, potent factors may be advanced to account for and to assist in interpretation of the data obtained by Lagatu and Maume. The concentration of certain soil nutrients in particular organs by no means reflects directly and definitely the rate or the proportionality of absorption of particular elements by a plant. Indirectly it may, and often does, indicate likewise the utilization of these elements by other organs, especially those of a higher metabolic rate and hence of a more rapid development. Due to a close physiological correlation of the various organs of a plant there is a continuous removal and diverting in unequal proportions of certain elements from particular organs, like leaves, and their reutilization for the development of other parts—fruits, shoots and roots. This is particularly true of woody perennials, like *Vitis* It has been demonstrated by one of the writers[8] and by others[9] [10] that every one of the three elements—nitrogen, phosphorus and potassium—is removed from the lower leaves of the tomato plant whenever a shortage of a particular element for the vegetative extension or fruit development occurs Yet Lagatu and Maume base all their interpretations solely on the analysis of basal leaves of fruiting canes of *Vitis* and of tuber-bearing plants of *Solanum* It is not difficult to see how the concentration of any two of the three major elements of soil nutrients may increase in the leaves when one is *in minimo* for the development of other metabolically more active organs This increase, therefore, is due to two major factors (not one) An unbalanced fertilization of the plant as a whole and an unbalanced nutrition of particular organs In either instance (below and above ground, the "intake" and "outgo," absorption and utilization) the law of the minimum seems to hold true.

---

[4] E J Russell, "Soil Condition and Plant Growth," p 102, 1927

[5] Th Remy-Brown, *Mitt Deutsch Landw. Gesell.*, 28 416, 1913

[6] T Wallace, *Jour Pomol and Hort. Sci.*, 7 1–2, 130, 1928

[7] A. Mitscherlich, "Die Bestimmung des Düngerbedürfnisses des Bodens," 1925.

The detailed mechanism and interpretation of the metabolism and physiology of organic correlation may be analyzed on the basis of "metabolic gradients," as suggested by Child.[11]

A E MURNEEK
E J GILDEHAUS

UNIVERSITY OF MISSOURI

THE MECHANISM OF CROSSING-OVER

DARLINGTON recently published in SCIENCE[1] (73 561–562) a criticism of my work[2] which might give the reader the impression that Darlington was not given credit for previous suggestions concerning the mechanism of crossing-over In 1929 Darlington[3] did suggest that crossing-over is due to a reduction of chiasmata by breaking In the three sentences which refer to this theory (pp. 50, 51 and 52) he does not explain how chromatids might break and recombine nor does he present any evidence to show that he had any conception of the significance of his suggestion. However, his suggestion was acknowledged (Sax, 1930, p. 209) as follows "It seems very probable, however, that crossing-over between homologous chromatids is associated with the reduction in the number of chiasmas between diplotene and diakinesis, as Darlington (1929) has suggested."

In a paper which was published shortly before mine went to press, Darlington[4] does not mention his earlier suggestion that crossing-over is caused by breaks in the chiasmata, but expresses the view that cross-overs determine chiasma formation The cytological evidence for this view is supported by a few diagrams and text figures which by no means can be considered as a "cytological demonstration of genetic crossing-over"

The fact that Darlington discarded his earlier "suggestion" on crossing-over in no way discredits or weakens my theory Darlington has made so many assumptions concerning chromosome pairing, and has changed his mind so frequently that one would necessarily have to cite one of his numerous theories in any discussion of crossing-over

Darlington also states that I have used diagrams and terminology borrowed from his 1929 paper The only term used which might be credited to Darlington is "terminalisation" No figures were borrowed from him, although my figures 9 and 10 are based on his work For this phase of my interpretation of crossing-over Darlington is given credit as follows "The behavior of the chromosomes in triploid Hyacinths described by Darlington (1929) seems to offer an explanation of triploid crossing-over" (p 214) The fact that Darlington did not fully appreciate the genetic significance of his cytological results in no way discredits his ability as a technician

According to Darlington, my "genetical remarks might be taken to favor either hypothesis—for there is no decisive evidence between them" This statement is of more than doubtful validity In none of Darlington's papers is there any explanation of the cause of breaks in chromatids, why they unite in new associations, why the two homologous chromatids almost always cross over at the same loci, of how gene duplication or deficiency could occur, or why one cross-over interferes with another In his most recent paper Darlington[5] (1931) simply ignores these difficulties and has to assume several improbable hypotheses to account for the absence of crossing-over in the *Drosophila* male All these genetic phenomena are easily and logically explained on the theory that crossing-over is due to breaks in chiasmata (Sax, 1929) The genetic analysis of chromosome behavior in *Drosophila* as developed by Morgan and his associates is a far more precise and accurate tool for the analysis of chromosome behavior than any method now available to the cytologist Any theory of crossing-over which does not meet the strict genetic requirements can not be considered seriously

---

[8] A. E Murneek, *Plant Physiol*, 1: 3–56, 1926

[9] J. H MacGillivray, *Jour Agr Res*, 34: 2 97, 1927

[10] G. Janssen and R. P. Bartholomew, *Jour Agr Res*, 38: 8. 447, 1929.

[11] C. M Child, "Individuality in Organisms" and "Senescence and Rejuvenescence," Univ of Chicago Press, 1915 Also *Plant Physiol.*, 1· 1–8, 1926

[1] C. D. Darlington, "The Mechanism of Crossing-over," SCIENCE, 73: 561–562, 1931.

[2] Karl Sax, "Chromosome Structure and the Mechanism of Crossing-over," *Jour Arnold Arb.*, 11. 193–220, 1930.

[3] C. D Darlington, "Meiosis in Polyploids II Aneuploid Hyacinths," *Jour Gen*, 21– 17–56, 1929

[4] C. D. Darlington, "A Cytological Demonstration of 'Genetic' Crossing over," *Proc Roy Soc*, B 107. 50–59, 1930

Darlington also states that my "genetical remarks" "are vitiated as evidence by his using the word chromosome in three different senses" In the paragraph referred to the term chromosome was not confined to one particular phase of meiosis, as should have been the case, but by no consistent or logical method of reasoning would it be possible to conclude that the word chromosome was used in three different senses or that the genetic evidence is vitiated

KARL SAX

ARNOLD ARBORETUM,
HARVARD UNIVERSITY

THE DIVINING ROD AND FAKERS

I READ with much interest articles in SCIENCE as to belief in the efficacy of a divining rod My explorations have taken me throughout the West and the South for nearly forty years We have frequently tried experiments, or rather permitted those who have faith in "rods," to test for buried objects I have never, in all my experience, known a single instance in which the test was of either practical or scientific value

To be specific During the exploration of the Cahokia Mounds, southern Illinois, there was much publicity, hence various persons with divining rods appeared One man's apparatus was different from the usual forked stick It consisted of a sphere about the size of a baseball at the end of a leather thong This contained certain ingredients which were "secret" and he claimed the ball would oscillate over treasure as well as Indian remains We afforded him facilities —the test was a failure A rather wild-eyed individual appeared and told me that if I would give him a "thigh bone of a big Injun" he could lay hands on said bone and thus come in contact with the Indian's spirit He was assigned quarters in a tent for a few hours, left in seclusion, and loaned a femur I asked him afterwards how he, speaking English, could communicate with a prehistoric Cahokian His reply was that all people in the spirit world spoke the same language!

The next season a middle-aged woman appeared and claimed ability to commune with departed Indians "now residing in the spirit world" My assistant and a workman were inclined to make sport, yet we gave her a tent and table at her request She communed for two hours Then she announced that we would make a great discovery somewhere within 2,000 feet, but was not specific The price to locate accurately was ten dollars!

Some weeks later a man appeared who claimed that he was an astrologer, contended that he had spent numbers of moonlight nights wandering over the Cahokia Mounds, that said mounds were orientated according to certain stars, etc, that if we would employ him he would spend clear nights, when stars were visible, in his studies He entered into a lengthy and somewhat erratic explanation, the upshot of which was that there were certain points where lines drawn from one star to another crossed, and the point exactly beneath [on earth] would yield important archeological specimens, etc He was very insistent but could not designate any precise spot in which we should excavate He also desired pay

In southern Ohio a "Hill Billy" appeared in our camp with the usual divining rod, and was given a thorough test We sent to the bank and got $25 in silver We buried it secretly a few inches below the surface, scattering dead leaves, removing all fresh earth The ball would sway at various points but didn't move when our friend passed over the "buried treasure"

At Cartersville, Georgia, a man came to our camp with his "divining rod" talk and begged for a chance to exhibit his prowess He remained with our party two days and was given two or three men with shovels to excavate wherever he indicated It seems that the other men made sport of their comrades who accompanied "Mr Divining Rod" and, therefore, to keep peace in my field party it was necessary to detail a fresh crew each half day! Many test pits were sunk, nothing was found, but the owner always had the same excuse of any other person with a divining rod, *i e*, that the treasure was further down In brief, each one had a good alibi In instances where we struck ledge or boulder clay, or outcrop of limestone, etc, the explanation was the same.

In every instance, in several states, I kindly explained to these people afterwards the utter futility of such efforts Each one, however, had supreme faith in his divining rod. Our friend in Georgia, who was with us longest, a simple-hearted and ignorant man whose family, I was informed, was in need, listened with some impatience when I urged that he throw away his rod and go to work. He answered in words which would apply to all these people, "Mister, I might give up my house, or even the old woman, but I ain't going to give up the divining rod. Some day it will make me rich!"

---

[5] C D Darlington, "Meiosis in Diploid and Tetraploid *Primula sinensis*," *Jour Gen*, 24 65–96, 1931

WARREN K MOOREHEAD

PHILLIPS ACADEMY,
ANDOVER, MASS

THE VISIT OF DR JAKOB E. LANGE

DR JAKOB E LANGE, well-known Danish student of the mushrooms, will arrive in New York the middle of August for several weeks of collecting in the northeastern United States and eastern Canada He wishes to study especially the parallelism and identity of American and European species of Agaricaceae A definite itinerary has been arranged Inquiries regarding its details may be directed to Dr C W Dodge at Pawlet, Vermont.

From August 28 to September 2 inclusive Dr Lange will be at Ithaca, New York. The region about Ithaca is especially interesting to him because Atkinson published over a period of years on locally collected materials Fungus forays will be made daily to near-by points of interest in the effort to see a large number of species

In order that the conceptions of species as held by Peck, Atkinson, Kauffman and other older American workers in the group may be clearly understood, it is imperative that Dr Lange be enabled to exchange ideas in the field with their students To this end American mycologists, especially those interested in mushrooms, are urged to come to Ithaca and cooperate in making these forays a success Students with only a minor interest in the Agaricaceae will also be welcomed, and the forays will be arranged in such a manner that collecting in other groups will be fruitful Incidentally, the Atkinson herbarium has been put in good order in recent years, and is now available for consultation in the new Plant Science Building at Cornell University

Those who plan to attend the Ithaca forays are asked to notify the undersigned at as early a date as possible Arrangements will be made for lodging, meals and transportation at reasonable rates Information concerning these items, or other features of the plans for the forays will be gladly given

H M FITZPATRICK

CORNELL UNIVERSITY,
ITHACA, N Y

REPORTS

UNITED STATES GEOLOGICAL SURVEY UNPUBLISHED LITHOGRAPHIC PLATES OF VERTEBRATE FOSSILS FOR DISTRIBUTION

Two hundred and thirteen of the lithographic plates prepared under the direction of Professor Othniel C Marsh are now being assembled to distribute for research and educational purposes to the principal active centers and libraries of geology, paleontology and comparative anatomy in this country and abroad The distribution is by permission of the director of the United States Geological Survey through the agency of the Department of Vertebrate Paleontology in the American Museum of Natural History There are also the original Cope lithographic plates, some from "The Vertebrata of the Tertiary Formations of the West," some from the Cope-Matthew volume, some which have never been published

Seventy-one sets of these assembled plates have already been sent out to various institutions in this country, seventy have been prepared for distribution abroad and three hundred and fifty are to be kept in reserve. Applications by libraries and laboratories for plates from this reserve supply should be addressed to the Curator of the Department of Vertebrate Paleontology of the American Museum

In this connection it seems of interest and importance to review briefly the circumstances surrounding the long history of these lithographic plates which began probably as early as 1878 when Marsh was working for the King Survey and just prior to his appointment as vertebrate paleontologist of the United States Geological Survey, formed in 1879 The Marsh-Cope plates drawn on stone by Mr F E Berger under the direction of Professor Marsh are masterpieces of the art of lithography which had reached a culminating point in England, Germany, France and America during the great foundation period of Leidy, Cope and Marsh, between the year 1850 when Leidy began his work and 1899 when Marsh's work was terminated by his death No modern reproductions can compare with the beauty of Berger's original plates, so that this opportunity of securing the originals will, it is expected, be eagerly availed of, and prompt response will be given to any application

The enumeration of the plates available for distribution and research is as follows

The Stegosauria, 63 plates
The Brontotheriidae, 60 plates
The Sauropoda, 90 plates

On the death of Professor Marsh in 1899, Director

Walcott, of the United States Geological Survey, invited the writer to supervise the preparation of Marsh's four incomplete monographs The materials were found to consist of over 200 carefully prepared lithographic plates, of drawings and wood engravings, some bibliographies and about one hundred pages of rough pencil notes and memoranda. There was no manuscript, the entire text of the four monographs remained to be written It was obviously appropriate to assign the Ceratopsia Monograph to John Bell Hatcher, because the discovery and collection of these animals was the greatest single achievement of his remarkable life, he had devoted four arduous years to bringing together these magnificent horned dinosaurs for Yale University and the National Museum. Hatcher entered upon this research in July, 1902, with his usual ardor and thoroughness, on July 3, 1904, when he was stricken down the work was taken up and completed in a most admirable manner by Professor Richard S Lull, of Yale University, it was published in 1907 as United States Geological Survey Monograph 49

The next volume, the Stegosauria, was assigned to Mr Charles W Gilmore, of the United States National Museum, who began work in 1906 and, although the monograph as originally projected was not finished, he published in 1914, as United States National Museum Bulletin 89, the work entitled "Osteology of the Armored Dinosauria in the United States National Museum, with Special Reference to the Genus Stegosaurus," which covers only the material in the United States National Museum, but which established its author as a leading authority on these armor-plated dinosaurs

Under the name "The Titanotheres of Western North America," research on the Brontotheriidae was begun by the present writer in the year 1900 and with the masterly aid of William K. Gregory was completed and published as United States Geological Survey Monograph 55 under the full title of "The Titanotheres of Ancient Wyoming, Dakota and Nebraska" in the year 1929

Meanwhile research on the remaining monograph, the Sauropoda, was independently begun by the present writer about 1902 with Mrs J K Mosenthal and, in 1912, with the aid of Dr Charles C Mook, of the American Museum staff The title of this volume, if the plan for its issue can be carried out, will probably be "The Sauropoda of the World."

The problem of preparing "The Sauropoda of the World" differs radically from the problems involved in "The Titanotheres of Ancient Wyoming, Dakota and Nebraska" first, in the fact that we have little or no antecedent history of this remarkable group The Sauropoda suddenly flash into being, to our present knowledge, towards the close of Jurassic time, fully formed and widely differentiated into a number of very distinct types, all of gigantic size and well fitted by their long limbs for the world-wide migrations which carried them to every continent, even including Australia. The central problem in the Sauropoda Monograph will, therefore, be the distinction of five or six outstanding generic or sub-family types together with the more or less speculative problem of their origin and the intensely interesting problem of the causes and means of their world-wide distribution and finally their extraordinary explosive extinction Remarkable additions to our knowledge have been made since the superb Marsh lithographic plates, and very clear diagnoses of Sauropod characters were given by Marsh Valuable collections have been made principally by the Carnegie Museum of Pittsburgh, by Wortman, Hatcher and Peterson under the direction of Dr W J Holland

The discovery in East Africa of the magnificent Tendaguru deposits explored by Eberhard Fraas, of Stuttgart, and others have been given preliminary descriptions by Dr Werner Janensch, Dr Hans Reck and Dr J G Pompeckj, of Berlin Dr F von Huene, of Tubingen, has recently revised Richard Lydekker's monographic work on the Sauropoda of South America Of great significance is the discovery of scattered remains in the Desert of Gobi by the Central Asiatic Expedition under Andrews and Granger, revealing what may have been the central or ancestral region in which these great animals enjoyed their original evolution It is planned, now that the Titanothere Monograph has been completed, to renew the researches on the Sauropoda with the attempt of coordinating this great mass of new material with the original ground material made in the discoveries and writings of Marsh and of Cope.

HENRY FAIRFIELD OSBORN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE ULTRA-CENTRIFUGE

IT is hardly necessary to emphasize the value of the centrifuge to science in general Its numerous uses in so many fields of experimental investigation have made it almost a necessary laboratory tool As a consequence of this wide usage considerable energy has been directed toward the development of centrifuges with our modern high speed machines as a result. However, there is still very much to be desired in the way of improvement. Many problems of ultmost importance remain unsolved because of the insufficient separating power of our best centrifuges. Among the factors which limit the separating power of the centrifuge are, of course, rotational speed, suitable bearings, strength of materials, troublesome vibrations, and simple means of making the centrifuging continuous. During the last few years we have been engaged in a series of researches that required apparatus for obtaining high rotational speeds Some time ago we undertook to apply this comparatively simple technique to the centrifuging problem and have obtained such remarkable results that it seems worth while to call the attention of others to its possibilities

The method of whirling the centrifuge consists in both driving and supporting the rotor by means of a whirling cushion of air By this procedure the maximum rotational speed is apparently limited only by the molecular speed of air and the strength of the rotating parts In some of our experiments we have obtained rotational speeds of approximately one half million revolutions per minute and centrifugal forces over a million times that of gravity The experimental arrangement for obtaining these high rotational speeds is a modification of one used by Henriot and Huguenard (*Comptes Rendus,* 180 1389, 1925, *Jour de Phys et Rad* 8 443, 1927) A detailed description of the method of rotation and the ways of measuring the rotational speed have been given previously (Beams, *Review of Scientific Instruments,* 1, 667, 1930) so that only a very brief sketch of this part of the apparatus need be given here

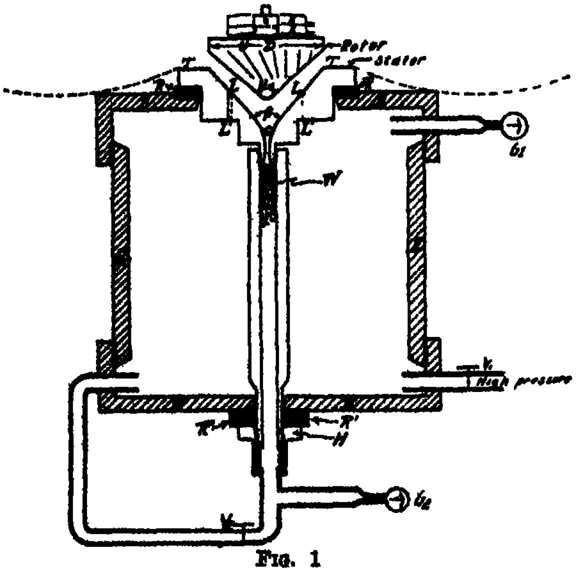


FIG. 1

Referring to Fig. 1, air from a compressor is admitted to the chamber through the valve V_1, until the pressure gauge G_1 registers the desired pressure V_2 is also opened until G_2 reads the proper pressure, which is found by trial The rotor is then placed in the position shown in the drawing The air jets from LL' and C impinge upon the flutings of the rotor, raise it, and start it rotating. Immediately it seeks a position of stable equilibrium a fraction of a millimeter above the surface of the stator, where it continues to rotate The air entering through C stabilizes the motion and makes it possible to obtain a greater range of speeds as well as gives a means of easily adjusting for different weights and slightly different shapes of the rotor In the case of the rotor, or centrifuge proper, the problem immediately arises of how to get the material to be centrifuged in and out without touching or rubbing while the rotor is at full speed Fortunately this problem can be solved in several ways If a small amount of material is to be centrifuged the arrangement shown in Fig 2 is satisfactory The rotor is filled with the liquid and allowed to come to full speed After the components of the liquid have had time to separate, a somewhat heavier substance, with which the liquid under investigation will not mix, is very slowly dropped into the tube AB (which is slightly larger at B than at A) This forces the lighter fractions out of the tubes EF where it is collected by the cylindrical collector K Fig 3 shows a scheme where the centrifuging is continuous The rotor is first filled through the tube AB then brought to full speed and allowed to rotate for some time More of the liquid to be centrifuged is then slowly introduced through AB and thus emerges at C Its heavier constituents move to D and the lighter to E where it is forced up the small hole EF and collected by the collector K_1 The heavier material is forced out through the tube DPG and collected by K_2 There are twice as many tubes as shown in the drawing MP has a symmetrically placed identical tube while NE (drawn in Fig. 3 at right angles to its real position) also has a symmetrically placed tube to keep the centrifuge in balance The distance of the tubes PG from the axis of rotation and the height of its opening depend upon the approximate ratio of the densities of the substance to be separated, so it is necessary to design the rotor specially for each ratio

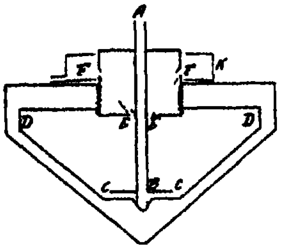


FIG 2

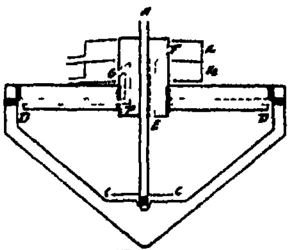


FIG 3

of densities It will be recalled that the practical separating power of a centrifuge depends not only upon the maximum magnitude of the rotational speed but upon the radius of the rotor as well It is found desirable to make the peripheral velocity as large as possible Fig 4 shows an arrangement that has some advantage and is very stable The size of the rotor can be varied over wide ranges We have used them, for example, from 1 cm to 10 cm in diameter, but the size apparently is not restricted Peripheral speeds of over 3×10^4 cm per sec have frequently been attained A convenient size one inch in diameter made of steel will rotate, when loaded with water, 3,500 revolutions per sec with the compressor giving only about 1,200 cubic inches of air at a pressure of 100 lbs per square inch above one atmosphere, per minute For this the angle of the stator $\beta = 91\ 5°$ and the angle of the rotor $\alpha = 103°$ The 8 holes LL′ were drilled with no 73 drill

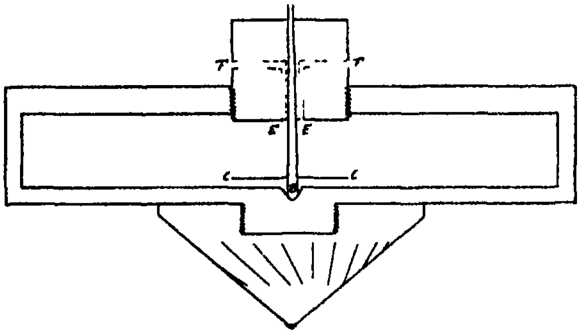


FIG 4

By adjusting the air pressure the speed of revolution can be varied over wide ranges The speed, however, remains remarkably constant when the pressure is held constant Another striking thing is the absence of vibrations in the rotor when filled with a liquid and the consequent reduction of stirring or remixing to a minimum The theory of separation by centrifuging should, therefore, hold with good approximation

J W BEAMS
A. J WEED

ROUSS PHYSICAL LABORATORY,
UNIVERSITY OF VIRGINIA

A METHOD FOR COMPARING GROWTH RATES BY MEANS OF A PROTRACTOR

IN growth studies on plants and animals, the investigator, in his examination of the data, wishes to compare not only the growth increments, but also the *rates* of growth The former may be done by the usual graphs, plotted directly from his records, but when he is contending with large amounts of data the numerous calculations of growth rates are time-consuming and become tedious The writer has employed a simple and rapid method for the inspection of growth rates directly from the increments graphs Although the method is not exceedingly accurate, it has proven to be of considerable aid in the general study of growth data.

The procedure is as follows. The customary growth increment graphs are plotted upon standard coordinate paper, being careful to locate each point accurately and sharply, and, in any series to be compared, the distances along the abscissa and ordinate allotted to the units of time and growth must remain constant throughout all sheets of graphs

The rate of growth is the *slope* of the graph between any two points or observations The value of this slope in degrees is easily determined by means of an ordinary transparent protractor One has simply to place the point of origin of the protractor exactly upon one point along the graph, and then to rotate the protractor until its basal axis is directly over the point marking the next observation The value of the slope between these points is read from the protractor over a line which is the continuation of the ordinate of the first point selected This value, for convenience, is written beside the particular interval of the graph measured Unfortunately, for this work, protractors are so numbered that the "90°" mark is at the top and the "0°," are to the right and left at the bottom, with the result that, the more rapid the growth rate, the smaller is the indicated angle corresponding to the slope To rationalize this, one may subtract from 90 degrees the value found, and then use the complimentary angle It is better, however, to renumber the protractor so that "0°" occurs at the top, and "90°" at the bottom to the right (the first quadrant only is used). Fig. 1 shows a growth increment graph with protractor in position for measuring the slope of interval "A."

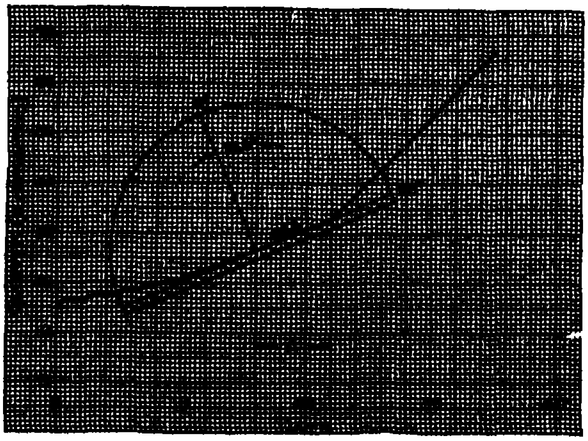


FIG 1

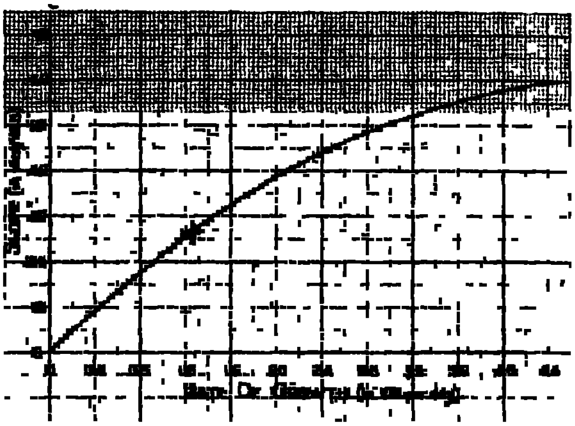


FIG 2

The values found are arbitrary in any series of graphs, but they are suitable for comparison either by direct inspection or by using them for plotting other graphs showing rates of growth If it is desired, however, the slope may be translated quickly to absolute rate of growth through reference to a curve, which is obtained by calculating from the growth data the actual rates corresponding to a few representative slopes Such a curve of reference is shown in Fig 2 When the slope of 26 5°, as found for interval "A" in Fig 1, is referred to the curve in Fig 2, it will be seen that this slope corresponds to a growth rate of 1 26 centimeters per day

The protractor method for determining growth rates is very simple and rapid, and it should be particularly useful when large quantities of growth records have to be studied

E M HARVEY

OREGON AGRICULTURAL
EXPERIMENT STATION

SPECIAL ARTICLES

ON MOLECULAR ORGANIZATION IN AMEBAN PROTOPLASM

THE question whether a submicroscopic organization exists in protoplasm has been considered with increasing frequency during the past several decades Among the more recent discussions come to mind those of H Przibram, R G Harrison, L J Henderson, J Needham, E J Lund, C V Taylor, G H Parker, W T Bovie and others The wide-spread and persistent interest in this subject is presumably due to the belief that the proof of the existence of submicroscopic organization would not merely add a new series of facts to science concerning the nature of protoplasm but would, in addition, serve to bring many observations on the form and behavior of organisms into relation which now stand by themselves And as a consequence, it would also serve as a good tool for further investigation in a number of lines of work

The data presented herewith seem to me to constitute evidence in support of the hypothesis of molecular organization in the protoplasm of four species of amebas Other data will also be presented as presumptive evidence tending to show that similar organization may be general among organisms and that certain large groups of hitherto unrelated observations fall into a coherent system under this generalized hypothesis Since the entire argument is based ultimately on molecular movements and displacements, a statistical treatment is probably the most appropriate method of handling the data

I When an ameba is placed on a thin glass rod or within a fine capillary tube of suitable size, the path which the ameba makes on the rod or within the tube is a helical spiral of greater or less regularity, depending somewhat upon the individual, the species and other factors The direction of the path may be to the right or to the left, for varying lengths of time, and may alternate frequently during the course of a few hours Of the four species investigated, three are predominantly *left,* making each about 1 4 left turns to 1 right, the other species, which readily hypertrophies, is predominantly *right* to a slightly greater degree

Now if one takes a convenient, small unit of measurement, such as one half turn around the rod or tube, and then measures all the right and left sections of path to the nearest half turn and arranges the sections in a frequency series based on length, a characteristic distribution is obtained for each species Thus for the 4 species *Rugipes bilzi, Mayorella conipes, Trichamoeba schaefferi, T sphaerarum,* the distribution in the higher categories closely approximates the exponential series represented, respectively, by the formulas

$$2^{-\left(\frac{y-1}{2}\right)},\ 2^{-(y-\frac{1}{2})},\ 3^{-(y-\frac{1}{2})},\ 4^{-(y-\frac{1}{2})},$$

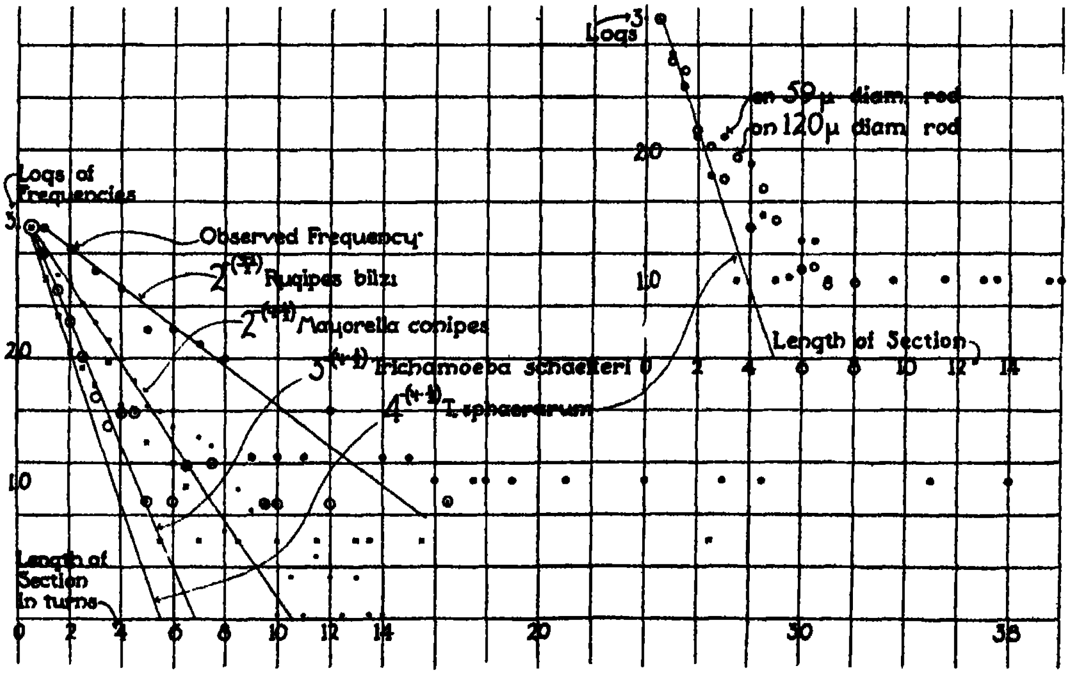
where y is the length of any section The data, representing 316, 3250, 322 and 615 sections respectively, of the above named amebas, are shown graphically in the figure (The points representing the lower categories on the figure, which have drifted off the theoretical curve and are believed to represent the operation of an added factor, will be discussed in a more extended paper to be published soon.) For convenience of graphic representation the observed number of sections are proportionated so that the highest category, y^0, equals 1,000 and the log of the numbers of sections in each category is plotted against the length of the section

(1) It will be noticed that the first two series noted above are alike numerically but that in the first ameba the steps or nodes in the path where changes of direction are most likely to occur, are twice as far apart as in the second, third and fourth amebas

(2) The series differ by *integral* steps

(3) A particular frequency may occur independently of the particular length of the internode between changes of direction

In general, these data show that there is a succession of "weak points" or nodes somewhere in the neighborhood of three and one half body-lengths of the ameba apart, for the last 3 amebas, and 7 body-lengths for the first ameba It is at these weak points or nodes that the direction of movement is more likely to change than at any other points. Statistically, the periodicity is remarkably regular



That the periodicity is not due to the recurring asymmetry of light and geotropic influences as the ameba moves around the rod, is shown in the graph in the upper right corner of the figure Two rods of different diameter were used in this series of observations, one 59 microns and the other 120 microns in diameter

(1) The frequency formula, each based on one half turn of the rod as a unit of measurement, is exactly the same for both rods, in the higher categories This would be expected mathematically

(2) For equal amounts of space covered on the 2 rods, the number of sections is not the same on both, nor about twice as great on the thin rod, as might perhaps be expected, but there are actually 40 per cent. more sections on the thin rod.

(3) The experimental conditions having been the same in both cases, the results stated in the paragraph above can not have been due to asymmetries in lighting or gravity but must clearly involve some function of the curvature of the rod.

(4) Whatever the length of the node as produced experimentally, the frequency of the breaks (degree of cohesion or field strength) remains the same

The frequency of changes of direction or field strength of the molecules of the first 2 species of amebas mentioned above is therefore exactly the same, but the nodes are twice as far apart in the first as in the second ameba But in the second, third and fourth amebas the nodes are the same distance apart but the field strength of the molecules differs systematically.

II. Another set of experiments bearing on molecular organization is concerned with the effect of light. Two of the above named amebas, *conipes* and *sphaerarum*, were subjected to the same technique as described above, excepting that the light was alternated in some experiments every 30 minutes, in others every 45 minutes, in others still, every 60 minutes, with light of lower or higher intensity. The intensity ratios, varying from 2 to 8, were secured by use of a light wedge, sector wheel or distance difference.

For the purpose of this discussion amebas may be divided into 2 classes: a larger class in which the total number of left turns is greater than the number of right turns; and a smaller class in which the right turns similarly predominate. It has been found experimentally that amebas predominating in left turns react to changes of light intensity that is exactly opposite and approximately equal to the reactions of predominantly right amebas.

(1) In both types of amebas belonging to the species *compes*, the average change of the left-right ratio of spiral turns in 5 different pairs of intensity alternations, comprising 2,000 turns, was found to be 18.6 per cent. more right turns in the *higher* intensity for the *left* amebas, and 18.4 per cent more right turns in the *lower* intensity for the *right* amebas.

(2) In *sphaerarum*, using 3 pairs of intensity alternations and comprising 1,009 turns, 22.4 per cent more right turns were produced in the *higher* intensity by predominantly *left* amebas, while 24.1 per cent more right turns were produced in the *lower* intensity by the *right* amebas.

(3) In the light of physical science these results, obtained by varying the light intensity, are interpreted as due to the action of light-activated atoms in the molecules, which causes these molecules to change their spiral twist from left to right or *vice versa*, depending upon the conditions of the experiment. But if these light effects are considered in connection with the periodicities and internodes, all of which are related integrally, then only one conclusion seems possible with respect to the nature of the underlying mechanism: it must be particulate and therefore molecular. This means, further, that high correlation between a structural or functional characteristic of an organism and a specific left-right ratio of spiral turns is a sign of a corresponding stereorelation between the atoms in the spiral molecule. In other words, high correlation between a specific left-right ratio and the presence of any characteristic of an organism means that the characteristic is a steric property of the spiral molecule. (The converse is of course not true, since there must be many steric displacements possible which do not throw the molecule as a whole from a left spiral twist into a right, or *vice versa*.)

Seeing that the spiral molecule is labile enough to be easily changed from one direction of twist to another by merely changing the light intensity one would naturally expect other physical or chemical agencies to produce similar changes. In illustration of such expectation two correlations, numbered III and IV are given immediately below. Following these are two other correlations, numbered V and VI, which point to a probable and very interesting statistical relationship between two very wide-spread characteristics of organisms and their distinctively steric characteristics.

III. Two of the species of amebas referred to above, *bilzi* and *schaefferi*, frequently hypertrophy markedly under some cultural conditions, when they become strongly right-turning and reproduction is rare or absent.

IV. A normally left-turning *sphaerarum* becomes strongly right-turning within 30 minutes after eating a large and easily digestible food object, and does not become predominantly left-turning again until after several hours have elapsed.

V. The direction of spiral twist of body in animals is negatively correlated, statistically, with the direction of spiral movement, in plants the correlation is apparently positive.

All motile organisms move spirally when guiding senses are not functioning, so far as known. By experiment and observation this has been found to hold true from bacteria to blindfolded aviators. Many organisms have spirally twisted bodies. Many others have some prominent unpaired organ spirally twisted. Many others, again, show no conspicuous spirality. The lack of spirality in the body of an organism is, however, not correlated with its property of moving spirally, for this class of organisms moves as definitely spirally and to the same degree as does the other class. The *mechanism of spiral movement* is, therefore, independent in its presence and in its function of the gross or visible spiral structure of the body. But there is a statistical correlation between the *direction* of the visible spiral structure and the *direction* of spiral movement.

(1) Of the 168 species of ciliate protozoa (Bullington), 146 belong to right-spiral structure groups and 22 to left-spiral structure groups. Of the 146 species belonging to right-spiral structure groups, 104 swim to the left spirally and 42 swim to the right. Of the 22 in the left-spiral structure group, 20 swim to the right and 2 swim to the left.

(2) Of 40 species of flagellates studied quantitatively, belonging mostly to the Euglenoidinea, almost if not quite all *show* left-spiral structure and all were found to swim to the right.

As stated above, many organisms swim spirally in which no spiral structure has yet been found, but if one uses the data derived from the study of the 208 species of ciliates and flagellates, which show definite negative correlation between direction of spiral structure and spiral movement, then the 102 species of rotifers studied, of which 92 swim to the right and 10 to the left, may be said to constitute a left-spiral structure group. Likewise also the 22 species of tunicates and salpas, which have been found to swim to the right, may be said to constitute a left-spiral structure group.

In addition to these data may be mentioned the snails, of which 15,230 are right spiral in structure and about 730 left (Leunis), but no observations have been found recorded as to direction of spiral movement of larvae or adult of any snails Three hundred species of dinoflagellates are structurally left spiral but the movements of only about a dozen have been studied carefully and of these, half are right-turning, one left, and the rest alternate from right to left, but the predominance of the last group is not recorded Volvox and some of its congeners are known to swim to the left, as do also the larvae of about 40 species of worms, bivalves, echinoderms and coelenterates—all that have been studied

Summarizing, it is seen that groups of organisms with left-spiral structure (assumed in rotifers) swim to the right predominantly in the ratio of about 10 right to 1 left, or greater, while right-spiral structure groups swim left predominantly in the ratio of about 2 3 left to 1 right

In plants, however, the situation is different The cyanophyceae and spirochaets are twisted to the left and the motile species swim to the left The spermatozooids of the characeae, mosses and ferns, so far as recorded, swim in the same direction as the body is twisted Among the spermatophytes, 48 out of 65 climbing plants turn to the right (Darwin, Cook) From the few observations recorded, motile plants are evidently unlike animals in that the plants move in the same direction as their bodies are twisted, but they agree with animals in that the lowest groups are almost all left in structure and the highest predominantly right in structure

VI The incidence of sex among the different groups of animals is also statistically correlated to a greater or less degree with right-spiral structure, and apparently also in plants Taking first the left-spiral groups among animals, we find, with only a very few exceptions, asexual reproduction among the flagellates, very great reduction in the size of the male among the Vorticellidae and the rotifers, and hermaphroditism among the tunicates The large groups closely allied to these, respectively, are right spiral in structure and sexual equality is the rule Of the living gastropods about 43 per cent of the species belong to the (hermaphroditic) Euthyneura and 57 per cent to the (unisexual) Streptoneura (Leunis) Approximately 10 4 per cent of the Euthyneura are twisted in a left spiral, while less than 2 of 1 per cent of the Streptoneura are left in structure Observations on about 40 species of worms, echinoderms, bivalves, crustacea and vertebrates, which constitute the remainder of definite data on this subject, indicate that these groups are predominantly right spiral in structure, since they *move* spirally to the *left,* the data are, however, too few in this particular case to do much more than excite a lively interest in collecting more data

Among the plants the same condition apparently holds. The observations are few and difficult to make, requiring first the development of a new technique for the ready detection of spirality. The lower plants, spirochaets, cyanophyceae, spirillum, are left in structure and sexless The spermatophytes, as judged by the climbing plants, noted above, are preponderately right in structure and sexual But the spirogyras are nearly all left in structure and reproduce sexually, although parthenogenesis is also present

Now taking together all the observations on the relation of sex to spiral structure, involving a number of groups of animals and plants, totaling about 17,500 species, of which the most of course are gastropods, there is seen to exist a comparatively high degree of correlation between the presence of left spiral structure and (a) absence of sex, or (b) marked reduction of sexual equality, or (c) hermaphroditism, on the one hand, and right spiral structure and equality of sex on the other In the light of the preceding experiments and observations, this points to the very interesting possibility that sex is also fundamentally a molecular property, usually associated with the right stereoisomeric molecule

We have here then 6 sets of observations which are definitely interrelated statistically At the bottom of these relationships lie gross spiral structure and spiral movement Of the 6 sets of data mentioned here, the first 2 sets, on periodicity and light effects are experimental and of course the most definite in pointing to the molecule as the mechanism underlying the observed reactions. The other sets of general observations, so far as they go, support this conclusion, and they are just such correlations as one would expect to find if the general principles of stereochemistry hold also in stereo-biology

Now an interpretation broad enough to include all these data requires that the protoplasm of amebas, and apparently of other organisms as well, be assumed to consist primarily of molecules, specific chemically for the species, which are organized into definite patterns The molecules must consist apparently of two fundamental types: right stereoisomers and left stereoisomers, which are not merely spatially different, but like the other stereoisomers of chemistry, they must also differ in some degree in other respects (Many other stereoisomeric conditions less deep-seated than these could of course exist) These isomers, in the case of organisms other than amebas, may give rise, most conspicuously, to a spiral structure of the body, which in many cases is more or less masked;

second, the right isomer readily falls into the two sexual phases, while the left does so comparatively rarely.

The organizing process of molecules at the forward end of the moving ameba is, in consequence, assumed to be accompanied by the formation of fields which derive their characteristics from the nature of the molecules; for there can be no (spontaneous) molecular organization without an accompanying field (comprising sub-fields). This field is the "organized aspect" of the organism. It follows from this that not only some but most or all of the characteristics of the organism are due to, or rather *correlated with positional relationships of the molecules*, and ultimately with the stereo-relations of the atoms of the molecules. It is, in fact, theoretically unique to suppose that a mass of matter, of whatever size, in a system (such as a molecule or an organism) can give rise to a particular characteristic of that system, for the characteristics of such systems as we know about are commonly held to be due to number and positional relationships of the constituent particles.

The experimental data on the amebas, on which the hypothesis of molecular organization is specifically based, will soon be published in full.

A. A. Schaeffer
The Biological Laboratory,
Cold Spring Harbor,
Long Island, New York

CERCOSPORELLA HERPOTRICHOIDES FRON, THE CAUSE OF THE COLUMBIA BASIN FOOTROT OF WINTER WHEAT

During the past eleven years an important footrot of winter wheat and barley has been under investigation in eastern Washington and Oregon. The symptoms already have been described in part.[1] An undetermined fungus, producing sterile, moderately slow-growing, compact, smoke-gray, mycelial colonies on Difco potato-dextrose agar, has been consistently isolated from young lesions that occur in the basal nodes of the culm. In special studies with this fungus conducted by the writer during the fall and winter of 1929 and again in the fall of 1930, at Corvallis, Oregon, the fungus sporulated profusely when grown on cornmeal and incubated outdoors. The fungus proved to be *Cercosporella herpotrichoides* Fron. Conidia were produced in slimy, pink masses, or pseudopionnotes, at the edges of colonies four weeks old. Conidia were developed also on loosely formed coremium-like structures, on sporodochia or microsclerotia, and to some extent on independent hyphae. The spores germinated at one or both ends and, in less than a week, produced the characteristic, smoke-gray colonies on Difco potato-dextrose agar.

Early in the spring of 1930, spores of *Cercosporella herpotrichoides* were found on lesions at the bases of culms of naturally infected wheat plants in the field near The Dalles, Oregon, and also on artificially inoculated wheat plants in the greenhouse at Corvallis, Oregon.

Artificial inoculations on wheat were made, in 1929 and 1930, in the greenhouse and in the field at Corvallis, Oregon, and in the field at three different points in and near The Dalles, Oregon. The fungus was carried through five mono-mycelial transfers before starting the pathogenicity tests. As inoculum for pathogenicity tests, the fungus was grown in quantity in flasks on a sterilized mixture of oats and barley kernels. In making the inoculations the fresh

TABLE 1

Results of Inoculating Wheat Plants with *Cercosporella herpotrichoides* at Corvallis and The Dalles, Oregon, 1929–1930

Location	Distance from nearest known naturally infected area, miles	When inoculated	Results obtained
Corvallis, Ore			
In greenhouse	120	At time of seeding, Oct, 1929, to Feb, 1930 Oct, 1930, to Jan, 1931	Typical footrot symptoms and also stunting and frequent death of seedlings
On college farm	120	Jan 3, 1930, 1 month after seeding	Typical footrot symptoms, including falling of culms
The Dalles, Ore	2		
In the country, elevation 2,800 feet		Oct 10, 1929, 6 weeks after seeding	Typical footrot symptoms except no falling
In the country, elevation 2,200 feet	5	Oct 10, 1929, 6 weeks after seeding	Typical symptoms, including falling
In a garden in The Dalles, elevation 150 feet	10	March 15, 1930, 5 months after seeding	Footrot lesions near maturity

---

[1] H. H. McKinney, "Footrot Diseases of Wheat in America," U. S. Dept. Agr. Bull. 1347: 28–30, 1925.

inoculum was crumbled and mixed into the soil at seeding time or later. The results of these inoculations are given in Table 1. In each case, uninoculated wheat plants grown as controls remained healthy throughout and the characteristic *Cercosporella herpotrichoides* was isolated from diseased wheat plants from the inoculated series at each place.

In a paper by Fron[2] in 1912, it is held that *Cercosporella herpotrichoides* Fron is the conidial stage of *Leptosphaeria herpotrichoides* De Not. However, in a subsequent paper, Foëx,[3] unable to substantiate Fron's claim, holds that the two fungi are not genetically connected. In a recent paper by Foex and Rosella,[4] an undetermined fungus from "eye-spot" lesions (le champignon des taches ocellées) is described that agrees, in cultural characters, with the *Cercosporella herpotrichoides* being studied by the writer. Foex and Rosella designate their organism as "champignon X." They also found *Cercosporella* spores similar to *C. herpotrichoides* on wheat plants grown in soil artificially inoculated with "champignon X." These writers state, however, that it is still uncertain whether "champignon X," the undetermined "eye-spot" fungus, belongs to this species or not. Dr. Foex recently sent the writer transfers of a pure culture of "champignon X" and it proves to be microscopically identical with the pure cultures of *Cercosporella herpotrichoides* isolated by the writer from diseased wheat in Oregon.

The only ascigerous stage of a suspected parasite that has been found on wheat footrots in the Columbia Basin area, aside from traces of *Ophiobolus graminis*, is a small amount of *Leptosphaeria herpotrichoides* De Not. found by McKinney[5] in Spokane County, Washington. A culture of a *Leptosphaeria* sent from Canada, referred to by Henry and Foster,[6] is distinct in appearance, on potato-dextrose agar, from the *Cercosporella herpotrichoides* studied by the writer and similarly different also from the culture received by the writer from Dr. Foex. The *Leptosphaeria* from Canada also differs from *C. herpotrichoides* in rate of growth on agar, at room temperatures, and in pathogenicity.

Fron did not give a formal technical description of *C. herpotrichoides* when he named the fungus, and correspondence[7] has failed to locate any type material. Fron's discussion and drawings lead the writer to conclude, however, that the fungus causing the Columbia Basin footrot is taxonomically identical with *Cercosporella herpotrichoides* Fron. Because of its prevalence in literature, the writer prefers to retain Fron's name and submits the following emended description based on the fungus as it occurs in Washington and Oregon.

CERCOSPORELLA HERPOTRICHOIDES FRON (EMENDED)

Fawn color to white, brown-bordered elongate (rarely circular) spots up to 3 cm in length, occurring on outer leaf sheaths at base of culms, later penetrating into interior of stems in spring of year or earlier, causing light-colored, later brown to black, charred-appearing lesions at the ground level, rarely higher, margins of lesions dark brown to golden brown, tissue of lesions firm and brittle, later sunken, culms eventually falling.

Mycelia septate, of two sorts: (1) Vegetative, yellow to dark brown, linear-celled, (2) stromatic, medium to very heavy walled, frequently consisting of polygon-shaped cells forming charred masses on the outside of stems or sheaths or occurring in cells in the interior of attacked culms. Conidiophores simple to slightly branched, sometimes swollen at the base and elongated, produced from macrohyphae subicula. Spores usually produced in spring of year on spots or lesions, frequently in pairs, often singly, somewhat curved, obclavate, two to several celled (mostly 5 to 7), variable, 1.5–3.5 x 30–80 μ (mostly 40–60 μ). On cornmeal (*Zea mays*), sporulation occurs in cool fall or winter weather, spores are produced in pseudopionnotes, coremia and loosely-formed sporodochial pads, spores strongly obclavate, blunt, sometimes pointed at apex, cells sharply constricted, somewhat doliform, 1.5–3.5 x 20–45 μ, on potato-dextrose agar, spores germinate usually from terminal cells but sometimes from any cell, and produce smoke-gray colonies of compact mycelia.

On culms of *Triticum vulgare* Vill. and *Hordeum vulgare* L. in Oregon, Washington and Idaho.

Material from natural infection on C. A. Johnson farm, High Prairie, Klickitat County, Washington, and material in pure culture on cornmeal from monomycelial transfers from scattered areas in the Pacific Northwest have been deposited in the mycological collections of the Bureau of Plant Industry, U. S. Department of Agriculture.

---

[2] G. Fron, "Contribution à L'Etude de la Maladie 'Pied Noir des Cereales,' ou 'Maladie du Pietin,' " *Ann. de la Sci. Agron. Francaise et Etrangere*, Année 29 (Sér. 4, Annee 1), Sem. 1: 3–29, 1912.

[3] Et. Foex, "Note sur le Pietin du Blé," *Bul.* de la Soc. Path. Veg. de France, 6: 52–56, 1919.

[4] Et. Foëx, and Et. Rosella, "Sur les diverses formes du pietin," *Rev. Path. Veg. et Ent. Agric.*, 17: 41–51, February, 1930. [Abs. in Rev. Appl. Myc., 9: 640–641, 1930.]

[5] H. H. McKinney, *loc. cit.*

[6] A. W. Henry and W. R. Foster, "Leptosphaeria Footrot of Wheat in Alberta," *Phytopath.*, 19: 689–690, 1929.

[7] The writer is indebted to Miss E. M. Wakefield, of the Royal Botanic Gardens, Kew, England, Dr. Geo. H. Pethybridge, of the Ministry of Agriculture, England, and to Dr. Et. Foëx, Institut des Recherches Agronomiques, Versailles, France, who so kindly assisted the writer in searching for type material of *C. herpotrichoides*. The writer also is indebted to Dr. Foëx for exchange cultures of footrot causing fungi.

Roderick Sprague

U. S. Department of Agriculture,
in cooperation with the
Washington and Oregon Agricultural
Experiment Stations

THE SEX RATIO AMONG HUMAN STILLBIRTHS

It has long been known that among human births there is a marked and fairly constant excess of males over females, the observed sex ratio for living births in the United States, for example, being about 105 or 106 males per 100 females. This surplus of males at birth might be explained by postulating a higher intra-uterine death-rate for females than for males. An examination of the sex ratio among stillbirths,[1] however, does not support this view; on the contrary, it discloses an even greater excess of males among those gestations which are interrupted prematurely than among those which terminate in normal, living births. The published data on this subject are adequately summarized in a paper by Holmes and Goff[2] and by Schultz[3] in his comprehensive study of the sex incidence in abortions, to which the reader is referred for a more detailed discussion of the matter.

The purpose of this paper is to call attention to the sex ratio computed from official statistics[4] covering 51,810 stillbirths which occurred in a selected area[5] of the United States, during the years 1926, 1927 and 1928. In Table I these cases are arranged according to their recorded sex and age. To aid in

TABLE I

Stillbirths from a Limited Area* of the United States during 1926, 1927 and 1928, showing the Number of Males and Females and the Sex Ratio, Arranged According to the Period of Utero-gestation

	Under 4 months			4 months		
	♂	♀	Sex ratio	♂	♀	Sex ratio
1926	170	52	326.92	359	165	217.57
1927	222	58	382.75	405	196	206.63
1928	205	57	359.64	470	192	244.79
Total	597	167	357.48	1,234	553	223.14

	5 months			6 months		
	♂	♀	Sex ratio	♂	♀	Sex ratio
1926	678	473	143.34	881	653	134.91
1927	756	541	139.74	1,096	868	126.26
1928	839	617	135.98	1,117	879	127.07
Total	2,273	1,631	139.36	3,094	2,400	128.91

	7 months			8 months		
	♂	♀	Sex ratio	♂	♀	Sex ratio
1926	1,052	941	111.79	1,184	989	119.71
1927	1,364	1,144	119.23	1,486	1,113	133.51
1928	1,340	1,136	117.95	1,421	1,164	122.07
Total	3,756	3,221	116.60	4,091	3,266	125.26

	9 months			10 months		
	♂	♀	Sex ratio	♂	♀	Sex ratio
1926	4,278	3,107	137.68	205	126	162.69
1927	5,088	3,712	137.06	186	126	147.61
1928	4,864	3,535	137.59	175	125	140.00
Total	14,230	10,354	137.43	566	377	150.13

Summary

Age	♂	♀	Sex ratio
Less than 4 months	597	167	357.48
4 months	1,234	553	223.14
5 months	2,273	1,631	139.36
6 months	3,094	2,400	128.91
7 months	3,756	3,221	116.60
8 months	4,091	3,266	125.26
9 months	14,230	10,354	137.43
10 months or more	566	377	150.13
Total	29,841	21,969	135.83

* Including Connecticut, Illinois, New Jersey, Oregon, Utah, Washington, Baltimore, Maryland, District of Columbia, and New York. (Figures for 1927 and 1928 include the entire state of New York; those for 1926 are for New York City only.)

---

[1] As employed by U. S. Bureau of the Census, the term "stillbirth" apparently includes all interruptions of pregnancy, regardless of their cause or the period at which they occurred.

[2] S. J. Holmes and J. C. Goff, "The Selective Elimination of Male Infants under Different Environmental Influences," "Eugenics in Race and State," II, 247–248, Baltimore, Williams and Wilkins Company, 1923.

[3] Adolph H. Schultz, "Sex Incidence in Abortions," Carnegie Institution Publication No. 275, Washington, 1921.

[4] Birth, Stillbirth and Infant Mortality Statistics for the Birth Registration Area of the United States, 1926, 1927 and 1928.

[5] Including Connecticut, Illinois, New Jersey, Oregon, Utah, Washington, Baltimore, Maryland, District of Columbia and New York. (Figures for 1927 and 1928 include the entire state of New York; those for 1926 are for New York City only.)

comparison, the number of individuals of each sex and the sex ratio are listed separately for each year and for each age group, while the last horizontal line of the table contains corresponding values for the three years considered together

The average number of males per 100 females for each age group is as follows less than 4 months, 357 48, 4 months, 223 14, 5 months, 139 36, 6 months, 128 91, 7 months, 116 60, 8 months, 125 26, 9 months, 137 43, 10 months or more, 150 13 It will be observed that in these data the excess of males among stillborn cases decreases, at first abruptly and later more gradually, up to and including the seventh month of pregnancy At eight and at nine months, the percentage increases again, due, probably, to the fact that the somewhat larger average size of male infants increases the likelihood of their incurring fatal injury during parturition

The very great excess of males recorded among embryos of less than four months' development should not, however, be accepted without some qualification It is probable that many listed as males in this group are really females, and that the observer mistook the clitoris for a penis, due to the similarity in appearance of these two structures during early development. Since, however, it is possible to distinguish between the sexes of human embryos as young as six or seven weeks, on the basis of the relative length of the urethral groove, the angle at which the phallus meets the body, etc, the sex of the majority of cases at which a qualified physician was in attendance was probably correctly diagnosed But we do not know what proportion of these earliest cases were examined by competent observers, so it can not be determined to what extent the apparent sex ratio of the group has been affected by this source of error Since, however, the sex ratio during the fourth, fifth, sixth and seventh months shows a constantly decreasing excess of stillborn males, it seems reasonable to assume tha the true sex ratio among those of less than four months' development is definitely higher than that of the next older group, in which the sexes should not easily be confused It is likely that the recorded age of embryos and fetuses in this material is based on estimates by the mother rather than on accurate measurements, yet in so large a number of cases this procedure should introduce no serious error

The findings of this study agree essentially with those of Nichols[6] and of Schultz,[8] in showing that the excess of males among stillborn children is much lower during the middle third of intra-uterine development than during either the first or the last third of it They suggest, too, that the wastage of male embryos during the first three months of pregnancy must be very great.

Much interest attaches to the sex ratio among stillbirths, especially among those which occur during the early months of gestation The available evidence concerning the relative number of stillborn males and females during the later months of pregnancy proves conclusively that the excess of the former sex at the time of conception is even greater than is indicated by the sex ratio among living births Information concerning the relative mortality of the two sexes during the first three months of development is of even greater importance in this connection, for more than 50 per cent of all abortions are supposed to occur during this time,[8] and it has been estimated that there is one abortion for every 4 5 pregnancies which proceed to term[7] Unfortunately, this is the very period for which the available statistics are least reliable The majority of early abortions are probably concealed, and, of those which are reported, information as to sex must, of course, be limited to those cases which occur after the external genitalia are distinguishable, *i e*, after the sixth week of development As pointed out above, however, there is reason to question the accuracy of the reported sex of even those cases

Once we have some reliable data on the sex of stillborn embryos during the period from the sixth to the twelfth weeks of intra-uterine development, it may be possible to estimate fairly accurately the sex ratio at the time of conception Such an estimate must, however, await the compilation of a large number of records of early cases in which the age and sex are known to have been determined by competent observers

WILLIAM WALTER GREULICH
UNIVERSITY OF COLORADO

BOOKS RECEIVED

BOWEN, EZRA. *An Hypothesis of Population Growth* Pp 238 Columbia University Press $3 75

JOHANNSEN, ALBERT *A Descriptive Petrography of the Igneous Rocks* Volume I Pp xxii + 267 145 figures University of Chicago Press. $4 50

MCCUTCHEON, THOMAS P, HARRY SELTZ and J C WARNER *General Chemistry* Second edition Pp xv + 533 Illustrated Van Nostrand $3 50

MILLER, WILLIAM J *Elements of Geology* Pp v + 495 330 figures Van Nostrand $3 00

NATIONAL RESEARCH COUNCIL OF JAPAN *Japanese Journal of Astronomy and Geophysics* Transactions and Abstracts Volume VIII, No 3 Pp 207 + 44 The Council, Tokyo.

PAGE, LEIGH and NORMAN I ADAMS, JR *Principles of Electricity* Pp xii + 620 319 figures Van Nostrand $4 25

WILLIAMS, ROGER J *An Introduction to Organic Chemistry* Second edition Pp xi + 585 Van Nostrand. $3 50

---

[6] John B Nichols, "The Numerical Proportions of the Sexes at Birth," Memoirs of the American Anthropological Assn, Vol. I, 267.

[7] J W Williams, "Obstetrics," 4th ed, New York, 1917 (quoted by Schultz)

SCIENCE

Vol. 74 FRIDAY, JULY 17, 1931 No 1907

Cancer Research and the Scientific Method Dr Ellice McDonald 55

Dr Hillebrand as I Knew Him Dr. E T Allen 60

Obituary
- *Memorials, Recent Deaths* 62

Scientific Events
- *The Albert National Park in the Congo, The Hygienic Exposition in Dresden, Research Program of the Illinois State Geological Survey, The Buffalo Meeting of the American Chemical Society, In Honor of John R Freeman* 63

Scientific Notes and News 66

Discussion
- *The Decline in the Average Length of Life* Timothy Leary *New Paleontologic Evidence on the Age of the Metamorphic Series of Northeastern Washington* C C Branson *The Basal Metabolic Rates of Vegetarians* Glen Wakeham and Louis A Hansen *Reaction of the Contents of Trichinella Spiralis Cysts* Dr W P N Canavan *Sex in the Louisiana Oyster, Ostrea Virginica* M D Burkenroad *Correction on Psyllid-Yellows* A M Binkley 69

Scientific Books
- *Seward on Plant Life through the Ages* Professor Edward W. Berry 72

Scientific Apparatus and Laboratory Methods
- *An Inexpensive Light Source for a Portable Microscope* Harold D Caylor, Truman E Caylor. *Apparatus for Rapid Drying of Solutions* Dr. Warren W Ewing 73

Special Articles
- *Thermoelectromotive Forces Produced by a Magnetic Field* Professor S R Williams *The Production of Dental Caries in Rats Fed an Adequate Diet* Dr C A Hoppert, P A Webber and T L Canniff *The Effect of Epinephrin Free Suprarenal Extract on the Specific Dynamic Action of Foodstuffs* Dr Alfred E Koehler 75

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal
Lancaster, Pa. Garrison, N Y

Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

CANCER RESEARCH AND THE SCIENTIFIC METHOD[1]

By Dr. ELLICE McDONALD

CANCER RESEARCH LABORATORIES, GRADUATE SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

Cancer is the most important problem of our time, for two reasons. first, because it kills people more than any other single disease (heart disease, which is higher in the mortality records, is a combination of heart and kidney and other diseases), second, because it has increased so greatly in incidence in recent times —62 per cent. more deaths in Pennsylvania in twenty-five years, 40.5 per cent. in Australia in ten years, 58.2 per cent increase in 50 American cities with more than thirty million total population in twenty-five years, and in somewhat lesser degree in all civilized communities. In Great Britain in 1928, more than 12 per cent of all deaths were from cancer, and a great insurance company has estimated the yearly loss from cancer in the United States to be about eight hundred million dollars.

Obviously the disease is a subject to warrant careful consideration and organized effort, for it touches the life of a great number of people What has been done about it? A devoted group of medical men in a number of countries have studied the disease in man and in animals for many years, with the result that the treatment of cancer has improved in two directions—improved surgical treatment and treatment by radiation, x-rays and radium.

In medicine, as in all other forms of human endeavor, real ideas are rare, methodical development of ideas, after these are suggested or discovered, is common. The development of the automobile, for example, was only an elaboration of detail after the idea of the internal combustion engine was discovered All else that followed, to our smooth-running motor cars, was elaboration and development of a central idea. In surgery, for these fifty years, the Pasteur idea of defense against the invading parasite has been the central purpose, and all surgery has been the elaboration of the idea of infection by micro-organisms of that French chemist, and this elaboration has been carried to a degree of detailed sophistication Cancer has had its share in gaining better surgical methods, improved technique and earlier diagnosis, to gain better results than the old results which were nil But surgery is only applicable to such cancerous growths which are easy of access, which do not involve a vital organ or have not produced additional subgrowths called metastases In other words, if the cancer can be completely cut out, surgery is of use, if it can not, surgery had better not be attempted Yet in the best clinics and under the best auspices, 75 per cent of cancers are not suitable for surgical treatment because extension of the disease has already occurred

---

[1] Address before the American Pharmaceutical Association, Philadelphia, April 14, 1931.

Another accident led to the knowledge of the value of radium, when Becquerel carried a small amount of that strange substance in his coat pocket and found that after some time a destruction of the tissue of his skin, amounting to an ulcerating sore, occurred This led to the idea that radiation from radium and, by analogy, radiation from x-rays, might be of use in the treatment of cancer Since 1910, we have been concerned with elaboration of detail in the use of radiation, with improving methods of application and perfecting apparatus So that now with surgery, aided by radiation under the very best auspices, about one third of all cancer cases, as they come, can be cured In this country, under the disorganized methods, it is very difficult to estimate the total number of cures of cancer, but, after several years of collection of opinions and statistics, the total percentage of cures in cancer is estimated at less than 10 per cent and more than five per cent of all cases treated

In fifty years of antiseptic surgery following the beginning of the Pasteur idea, and in the twenty years following the idea of Becquerel and Curie, we have been able to develop only two methods of treatment for cancer, neither of which gives anything like satisfactory results, but we use them because they are the only ones available Both of these methods resulted more from happy accident than from any really intelligent investigation of the problem They were not even the result of trial-and-error method of research, but they happened because one was interested in the care of vineyards and because another received a burn from a rare and new substance Yet these two methods, surgery and radiation, are at the present time the only available and responsive measures for the treatment of cancer, and, with them, the very best we can hope is to cure one third of all cancer cases, obviously a confession of failure.

In these fifty years, research in cancer has not been without earnest activity, yet the pertinent facts collected have been few Many men have devoted their lives to this or that phase of cancer research and yet the total sum of knowledge has not been noticeably advanced It reminds me of my daughter, who has recently become engaged to be married and brought home four great books Being always interested in books, I asked, "What have you there?" She said "Before beginning any problem, you told me to collect all the available data, and these are cook books" Maybe cooking is the most important phase of the marital state and yet possibly other uncorrelated human activities, in a lifetime of mutual association, may also enter In research into cancer (and it has been almost entirely by medical men), there has been a similar lack of correlation and lack of coordination No definite consideration of the problem has been taken any more than in any other medical problem, except that "here was a disease and how can we cure it" Such research as has been done in cancer has followed the trial-and-error type of research, as is familiar to the medical investigator under the term the empirical method

Yet why should it be so? Life is a very definite reaction which occurs and recurs according to definite constancy, and cancer is only a problem in the reproduction of a life history of cells, for cancer is a problem in cell division A disease, such as cancer, is not a thing but a state, a deviation from normality. The cells, after our youthful growing period, have ceased to grow with arrival at adult age, or certain inhibitions to growth have occurred In cancer, which is generally a disease of the latter half of life, certain cells have lost their inhibitions to growth and renew their power of division into a multiplicity of cells, almost always beginning in a local area These cells are carried to distant parts of the body and maintain there the characteristics of the original cells, including their power of division and multiplication Death occurs from extension of these cells as a growth to some vital organ impairing its functions, to a general extension of the growth producing such poisons as to alter the functions of the blood and other parts of the human organism, or by creating such obstruction, or lowered resistance, so that a terminal and fatal bacterial infection results

The disease is a cellular disease so that the cell, the smallest particle capable of sustaining life, is our unit, as the atom is the unit of the physicist and the molecule of the chemist All life forms are colloid in character and we have to do with a heterogenous system, elaborated into a polyphasic organization and with definite structural arrangement. The chemical complexity of the cell would be baffling were it not that there are phenomena which are common to all cells. Nature at some stage in her complexity rejuvenates her simplicity. The atom, the unit of the physicist, by structural associations, forms the molecule which is equally satisfying to the chemist. The molecules form the cell where there is again renewal of the simplicity.

The cell, in the study of cancer, is the unit and has a definite arrangement or organization. It is possible to create a model for thought exactly as the physicists create a model of the atom. In fact, cancer research is going through the same stages of development as has physics. Twenty years ago, physics seemed at the end of its great discoveries and all else seemed to be elaboration of detail. There was an atom, the smallest unit, which was described in terms of (1) words. Along came Nels Bohr and Lewis with the construct or (2) a fixed model of the atom. This was developed into Bohr's atom with its moving orbits and relation to Planck's constants, (3) a model in terms of operation. This was again extended to the Schroedinger wave dynamics which only can be described in the language of (4) mathematics.

In cancer, and indeed in all biological and medical research, we are just emerging from the (1) word stage. But it is possible to begin the advance to the second stage of construct or (2) the fixed model. Lord Kelvin said "I never satisfy myself until I can make a mechanical model of a thing. If I can make a mechanical model of a thing, I can understand it. As long as I can not make a mechanical model all the way through, I can not understand it."

In cancer research, it is possible to take as a construct, or a fixed model for thought, the cell with the component parts of its system. The cell consists of (1) the nucleus, (normally with a pH of about 7.5), (2) the protoplasm (normally with a pH of about 6.6), (3) the cell membrane, and (4) the environment, which is the blood (with a normal pH of 7.38 and more alkaline in cancer) and tissue juices. The environment must be considered, for the cell and its environment are one. All energy forms, and the cell is an energy adapter, are brought to the cell and so enter the cell through the environmental phase. In consideration of alteration in cellular reactions, the environmental phase is of the greatest importance because alterations in this phase determine the reactions of the cell, and through this phase must go any influence, excepting radiation, which will prevent the cell division or cure cancer. Part of the mistakes in the study of cancer in the past have been the consideration of the cell alone as studied through the microscope in dead and stained preparations. In this, the most important phase in determining cell activity, the environment, was not considered.

Our unit system may therefore be thought to consist of four distinct portions: (1) nucleus, (2) protoplasm, (3) semi-permeable cell membrane, and (4) the environment from which the cell receives its energy-producing materials and through which the products of reaction are removed. The protoplasm is an intimate association of salts, carbohydrates, fats and proteins, many of which are specific to a high degree and which are partly contained in true solution and partly in a poly-dispersoid state.

In the continual exchange of materials and energy, the processes of oxidation-reduction are of outstanding importance. If we deny a cell oxygen, it either gradually ceases to function and dies or, like yeast, it adapts some form of anaerobic break-down in place of oxidation; if anaerobic break-down fails, the cell then perishes.

Life is an oxidation-reduction rhythm dependent upon oxidation-reduction potential which decides which one of two systems will oxidize the other. Since the process involves a transfer of electrons from oxidant to reductant, we may, by an adaptation of the Nernst formula, arrive at the following equation:

$$E_h = E_o - \frac{RT}{nF} \ln \frac{(Red)}{(Ox)}$$

where E_h is the voltage with respect to the hydrogen electrode as O, E_o is the normal electrode potential, *Red* and *Ox* the concentrations of the reductant and oxidant, respectively, T the absolute temperature, and R the gas constant. It is important to recognize that this treatment applies to only perfectly reversible processes and herein lies the difficulty of applying it to vital systems whose processes are not generally reversible. However, many biological oxidations which are apparently irreversible proceed by a number of stages, some of which are truly reversible.

The oxidation-reduction potential decides in which direction the reversible reaction will proceed, but the rate is determined mainly by the oxidative catalysts whose influence must therefore be a most essential factor in the problem. In these cell oxidation-reduction processes, there are living catalysts which are known as "the dehydrogenases or dehydrases." Their function is to activate molecules so that they act either as hydrogen donators or hydrogen acceptors, depending upon the nature of the molecule and the conditions of reaction. The so-called inorganic ferments, or heavy metal catalysts, also play a great rôle in vital oxidation-reduction processes In the living cell, other chemical substances form reversible oxidation reduction systems, the most important of these being the sulfur compounds of the type RSH–R-S-S-R, the former being the reduced form In this class are the cystine-cysteine and the glutathione-reduced glutathione systems and, in addition as oxidation-reducing systems the fatty acids and carbo-hydrates

There is no doubt, in life processes, that a steady dynamic state exists which is not chemical equilibrium, but which may be conveniently spoken of as biological equilibrium, and through which energy may be liberated

The normal processes of the living cell are brought about by a continuous energy interchange which is dependent upon the physical, chemical and colloidal state of the cell constituents and which, in its explanation, must be correlated to the fixed model of the cell with its four component systems of (1) nucleus, surrounded by (2) protoplasm, enclosed by (3) cell membrane, and existing in (4) environment

These processes are dependent upon two great factors (1) conditions of biological equilibrium or balance, and (2) catalysts of the oxidation-reduction type Their alteration in activity is influenced by conditions of biological equilibrium For example, F G Hopkins has shown that glutathione (GSH) promotes the oxidation of certain unsaturated fatty acids, the O being transferred to the unsaturated linkage of the fatty acid, while the original SH groups are reconstituted At pH 7 4–7 6 the system, GSH + unsaturated fatty acid, behaves differently, here the O uptake is equal to the amount required to oxidize the SH The SH group is no longer an oxygen carrier but becomes represented by $AO_2 + B \rightarrow AO + BO$ where A is an auto-oxidator and B an acceptor On the acid side of pH 7 4 the protein SH is oxidized and the total O amounts to ten times the O equivalent of the SH, at pH 7 4–7 6 the O uptake amounts to only sufficient to oxidize the SH This is significant of the influence of conditions of biological equilibrium on the effect of catalysts (or as the biologists call them enzymes) It is also significant that, in cancer, the blood, or (4) environment of our fixed model, has been found, by us, to be considerably more alkaline or averaging pH 7 44, where normal blood plasma is pH 7 38

The oxidation-reduction equilibrium (rH) which is the analogy to the intensity of acidity or pH, is of enormous importance to these vital oxidation-reduction systems The rH is a negative logarithm of the hydrogen pressure in equilibrium with the oxidation-reduction system in question In simple systems, rH is a function of pH and Needham and Needham have shown that it holds similarly for living cells, that rH is a function of pH. Our only and main interest in pH is that it gives some measure of rH and is an easy and exact measurement capable of statistical estimation. The ideal is rH measurement; the means are pH measurement.

There is, therefore, to be considered (always remembering our fixed model with its four component system) a scheme as follows

VITAL CELL SYSTEM INFLUENCES

Catalysts (enzymes, etc)	Condition of biological equilibrium
Glycolytic enzyme	pH
Co enzyme	rH
Fe in the hemin form	Ionic concentration of inorganic substances
Glutathione-reduced glutathione	Glucose concentration
Cystine cysteine	Aggregation and dispersion of the colloid
Dehydrogenases including (1) heat labile catalysts acting on the substrate (2) intermediate reversible H and O acceptors and (3) heat labile oxidants sensitive to CN	*Buffer systems* Phosphates Carbonates Proteins oxy Fe–red Fe RSH–R S S-R

In such a scheme as this, it must be decided where these reactions take place, in what part of our four component system? This is the mechanism of energy adaptation in the cell and, in cell division, there is an enormous increase in energy turnover, over one thousand per cent increase in certain cells, as has been shown by Joseph Needham, after fertilization of the *Ameba Proteus*

Mechanism, in cancer research, is much more important than cause or end results, which have heretofore been the main efforts. Cancer may be produced by tar and other means which points to the fact that the cause of cancer is a state of the cells, favorable for division and produced by more than one stimulator The end result is the tumor or the fixed dead stained preparation under the microscope. To attempt to reconstruct the mechanism of cancer from the microscope preparation is as hopeless as to reconstruct a bolt of lightning from the devastation it produces

Glycogen is the sole source (or almost) of cell energy. Warburg and his coworkers have shown that in cancer the glycolytic activity of tumor tissue is greatly increased For every thirteen sugar molecules attacked, twelve are split up into lactic acid and one oxidized, while in normal tissue this ratio is approximately 1: 1 Mellanby and Harrison have shown that cancer tissue does not form lactic acid from the Robison ester, while normal tissue does These findings make it necessary to postulate a different *mechanism* for the formation of lactic acid by cancer tissue or, in other words, there is deviation of the reaction in cancer cells from normal cells As an energy adapter, the cancer cell follows a different mechanism from normal This is one of the most significant facts of present-day cancer research If it were possible by alteration in the cell influences, as shown in the table, toward restoration of normal metabolism (or reactions) cancer would be cured, because the only perceptible difference between a cancer cell and a normal cell is a difference in metabolism The nature of the injury to the oxidative processes in the cell is the fundamental metabolic problem in cancer and the cure of cancer will come through the production of a more oxidizing potential than the limiting oxidation-reduction potential necessary to cell proliferation

In our laboratories, we have shown that, in general cancer blood plasma (or (4) environment) there is a relative alkalinity amounting, in untreated internal cancers, to a change from normal pH 7.38 to pH 7 47, or approximately 18 7 per cent, more alkaline These changes of pH may seem small to the chemist but they are enormous to the biologist In cancer, therefore, there are alterations in conditions of biological equilibrium (see table) of pH which involves alteration also in rH and alteration in the action of the catalysts as each, no doubt, has an optimum pH at which it is effective and with alterations in pH, the catalyst either is not effective, or new catalysts come into play. In other words, alteration in conditions of biologic equilibrium may produce alterations in mechanism of reaction

Our observation that, in untreated cancer, the duration of life is a function of pH and the more alkaline the blood plasma pH of the untreated patient, the quicker the disease kills, is significant of the influence of conditions of biological equilibrium upon the growth of the tumor and course of the disease.

Another interesting finding, which apparently has considerable evidence, is that cancer patients have relatively more sugar in their blood than normal and that, generally speaking, the more sugar in their blood, the worse is their expectation of life This is borne out by our preliminary investigations, although the problem is still being studied.

In addition to these facts, it has been pointed out by Clowes, Rohdenberg and others, that cancer cells have relatively less calcium than normal and relatively more potassium and that, with increase of potassium content, there is an increase of the virulence of the tumor, or the virulence of the tumor is (in part, at least) a function of the potassium content In our own laboratories, we have often found that, in spontaneous mouse tumors, calcium salts have an inhibiting influence on the growth of the tumor

With these few facts, we can begin to state the direction in which research must tend In order to have a cure of cancer, conditions must be produced which will (1) alter glycogenolysis toward normal from the cancer type, (2) produce conditions of biological equilibrium towards normal from the alkaline state (pH 7 47 in internal untreated cancer blood plasma), (3) reduce the high blood glucose, (4) produce a calcium-like effect, (5) reduce or prevent the potassium-like effect.

These criteria are few, but at present these are the sole criteria for a cancer cure and the future will lay down more and more specifications until these become so obvious to some genius, who will say that with those specifications the answer can only be one thing to satisfy all the requirements

In any consideration of these criteria, due consideration must be given to the conditions of mechanism as shown in the table, because mechanism is more important than results of reaction If we know the mechanism, it may be possible to throw a monkey wrench into the wheels, and alter that deviation from normal reaction which is characteristic of cancer cells.

Trial-and-error methods of experimenting with one thing after another, characteristic of past cancer research, is a hopeless job Human experimentation is limited because it takes at least six years for one experiment and, during that time, one can not deny to the patients the beneficial effects of radiation treatment, which masks the result of the experimental treatment Animals with their shorter lives are available for treatment with chemical substances, but it takes at least six months to put one substance to trial, and, in the three years, we have been continuing some animal experimentation in our laboratories and testing a comparatively few substances, at least 100,000 new substances have been produced by the organic chemists So the trial-and-error type of experimentation offers little hope, only a gambler's chance—a 20,000 to one shot The past experiment offers no indication as to what the next should be.

The attempt, however, to estimate the available data and to lay down specifications for the alterations required in producing a deviation from the cancer metabolism towards a normal mechanism, offers hope of the application of the scientific method to cancer research, so that each set of experiments will produce data to extend knowledge and lay the basis for future experimentation.

Cancer research in our laboratories is the study of oxidation-reduction rhythm in vital systems as influenced by conditions of biological equilibrium and affected by catalysts, always considering the four component system of the cell and its environment The foregoing may seem a simple sentence but it has taken me thirty years of my life to get there

Continuation of experimentation along lines of the scientific method, in distinction to the trial-and-error method, can not but end in that consummation, devoutly to be wished for, a chemical cure for cancer, which, in my opinion, is only a matter of time and trouble How much time and how much trouble remains to be seen Cancer study is a problem in applied science which needs the united efforts of chemist, physicist, cytologist and biologist, and this cooperative and coordinated union in scientific effort is as much the product of American adaptability as is quantity production in manufactures This united effort implies no deterioration in quality from so-called pure science, and is the united determination to solve a problem, even such a difficult one as cancer, by the assemblage of knowledge and mutual cooperation of scientific men and women

DR. HILLEBRAND AS I KNEW HIM[1]

By Dr E T ALLEN
GEOPHYSICAL LABORATORY, CARNEGIE INSTITUTION

THE purpose of this occasion is to honor achievement, past and present A more fitting memorial to Dr Hillebrand could not have been conceived We think of him as a man of achievement, other aspects of his comparatively uneventful life would have little interest for us

In recalling briefly the outstanding formative influences of his career, those early years in Honolulu come to mind Dr Hillebrand was born in the Hawaiian Islands, less than a century after the white man first set foot on those shores But if the circumstance of that early environment left any permanent impress on his temperament or his imagination, I have been unable to find it Dr Hillebrand rarely alluded to this period of his life It seems to have been but an episode

Dr Hillebrand's father was a German physician who came to Honolulu for his health He became deeply interested in the luxuriant tropical plant life about him, studied it, became an authority on the subject, and is to-day I believe the classic authority on the botany of the Hawaiian Islands Dr Hillebrand once told me that he had accompanied his father on many of his botanical expeditions, but that he never became interested in botany However, the fact that his father was an intellectual man, of broad training, with the ability and the initiative to make himself an authority in any branch of science, must, I think, be counted an important influence in the after life of his son

Dr Hillebrand's formal education was unusually complete After two preliminary years at Cornell University, he was sent to Germany in the early seventies, where he remained for six years He studied at Strassburg and at Heidelberg At Heidelberg, where he took his degree, he became a pupil of Bunsen and of Kirchhof, colossal figures in the world of science then, as they are to-day Twenty-five years ago, as chairman of the program committee of this society, I prevailed upon Dr Hillebrand to give us his recollections of Bunsen He regretted that much of a personal character had faded from his memory, but he left no doubt in the minds of his listeners of the profound respect he bore to Bunsen and the powerful influence Bunsen had exerted on his own career

To the German university Dr Hillebrand doubtless owed much besides his purely technical training, ideals of thoroughness, accuracy and breadth While perhaps not a man of the widest interests, he had a very broad perspective, much broader, I should say, than that of the ordinary professional man Much of this, I think, was derived from the grand precept of the German university, that any department of human knowledge, no matter what its popularity, was entitled to the same respect as every other

At Freiberg Dr Hillebrand attended one of the most famous mining schools in the world, where he was grounded in such subjects as geology, assaying and metallurgy (metall'urgy, as he always called it after the German pronunciation)

In 1879, we find Hillebrand in Leadville, Colorado, one of the important ore-producing centers of the day, where he worked as an assayer Shortly afterwards he joined the Geological Survey and a little later came to Washington where he remained in the government service to the end of his life

I first met Dr Hillebrand thirty years ago at the old Hooe Building on F Street, then occupied by the Geological Survey, since razed to make room for the National Press Club Had you called on Dr. Hillebrand at that time, you would probably have come away with the feeling that he was not a very aggressive man, not especially social or entertaining, but refined, dignified and distinguished On further acquaintance you would have found him pleasant in his personal relations and thoroughly satisfactory to cooperate with, a man of the highest integrity and conscientiousness If you had had opportunity to watch him at his work, you would have been apt to find him sober, silent and absorbed While not a man habitually gloomy, he was not noted for cheerfulness, optimism, exuberance or even enthusiasm His most loyal friend would never have thought of proposing his name for the Rotary Club

---

[1] Delivered before the Chemical Society of Washington on the occasion of the award of the Hillebrand Prize to C S Hudson, March 26, 1931

One of Dr Hillebrand's outstanding qualities was intellectual honesty I have rarely known a man so little apt to misrepresent or overstate the facts in order to score in an argument, or to overemphasize the importance of his own work

A man essentially judicial in temperament, deliberative but not slow, he has surprised me by the speed with which he would grasp the gist of a scientific article, and in the laboratory work of the department none of his coworkers ever equalled his output

For many years a pillar of this society, Dr Hillebrand was not much inclined to join in its discussions, except perhaps when they concerned the American Chemical Society, and he never "gave talks" He habitually read from the manuscript papers carefully worked out His distinguished figure, with the massive head and flowing beard, will not soon be forgotten

In choosing analytical chemistry as his life work Dr Hillebrand entered an old, old field and he usually approached it by well-worn paths Not an innovator in the usual sense, he invented few new methods, devised little apparatus useful in his art He will be remembered chiefly as a refiner and systematizer Two important principles, neither of which was new with him, he was very fond of applying One was the principle of double precipitation in gravimetric separations Before reading Hillebrand's book I had thought of double precipitation as something to be used only in work of unusual accuracy, in especially skilful hands, otherwise just another opportunity for mechanical losses From Hillebrand I learned that in many of the commonest separations, that was the wisest course to pursue My ideal analytical method had been one that combined optimum conditions, suitable for all possible proportions of the two elements to be separated Hillebrand convinced me that few such methods exist, but that by a single precipitation one could always come to the same case, namely, a great excess of the element to be determined and a minimum amount of the other This case can be very easily handled

Corrections have doubtless been applied to scientific measurements since early times, more frequently in those sciences where the measurements are characterized by a larger mechanical factor than they are in chemistry Outside of special researches they had not been much used in chemistry before Hillebrand's time He taught the importance of systematic corrections in all chemical work that made any pretension to accuracy

It may interest some of you to know that Hillebrand attached no special importance to his manual skill He once said that if he had any advantage over other men in his profession, it was not by reason of his skill of hand, but because of his broader experience—and, he might have added, his intelligence

There was one circumstance in Dr Hillebrand's environment at the Survey which might have seemed, to an outsider, a handicap, but which really proved an advantage to him As long as he stayed at the Survey, despite the standing he had in his profession, he was always subject to call, for a certain amount of routine work But this he made an opportunity for trying out his methods under all sorts of conditions and thereby bringing them to a higher state of perfection

As a systematizer also, it seems to me, we owe much to Hillebrand In a good course in qualitative analysis, if the student learns anything, it is *system* In quantitative analysis, as formerly taught, he was given a book of fragmentary recipes If he wanted to make a complete analysis, especially of some complex substance, he found no clear and logical course to follow Hillebrand makes the course clear

I have said that Hillebrand was not an innovator in the usual sense Shakespeare was not much of an innovator His plots are generally taken from earlier sources Very little changed, you may find many of them in the works of the old chroniclers Much of the dialogue in some of his plays may be found in Plutarch Yet Shakespeare did something to those old stories He didn't invent them, he transformed them Not to the same degree, of course, but still in a very true sense I think it may be said that Hillebrand transformed the methods that he made his own Taking many of his materials from the junk heap of tradition, he shaped them to his purpose and formed from them a tool which he sharpened into a precise instrument of wide application

This is not all that Dr Hillebrand did He made important contributions to mineral chemistry Later at the Bureau of Standards he began with Lundell a work of broader scope But if he had done nothing but his analytical methods, his fame I think would still be secure.

From conversation with Dr Hillebrand many years ago, I learned that, even as a boy, he felt a strong predilection for chemistry He apparently had a bent from which he was not to be turned aside by the allurements of botany or metallurgy He followed that bent, and by the least spectacular of methods he achieved distinction.

This society may be said to have possessed its fair share of men whose work is of more than average merit, but I doubt if there is any other who has produced anything that is so often and so widely used as Dr Hillebrand's analytical methods

OBITUARY

MEMORIALS

An international committee has been formed to establish a memorial to the late Albert Brachet, professor of anatomy and embryology in the University of Brussels, who died on December 27, 1930

A correspondent writes "Professor Brachet was noted for his work in the embryology of vertebrates and more particularly for his experiments on the early phases of development of the amphibian egg. His good sense, devotion and unusual personal charm won for him a high place in the councils of science and education. American colleagues who met him on his extended tour of the United States two years ago will long cherish his memory" The American members of the committee are: Professor E G Conklin, Princeton University, Professor Ross G Harrison, Yale University, Professor F R Lillie, University of Chicago, Professor T H Morgan, California Institute of Technology, Professor E B Wilson, Columbia University

The committee is asking for subscriptions to a fund to be used (1) to found a triennial or quadrennial prize, to be awarded for the best work appearing during that period in the field of embryology, especially that of causal embryology, open to the entire world and to be awarded by the Belgian Academy of Sciences, and (2) to place a memorial tablet to Professor Brachet in the entrance hall of the Institute of Anatomy in Brussels To subscribers of one hundred francs or more a reduced replica of the medallion will be given Student subscribers will receive the replica for gifts of fifty francs or more.

Subscriptions should be sent directly to MM Philippson, Banquiers, 44 rue de l'Industrie, Brussels, Belgium, and marked "Manifestation Brachet"

We learn from the *Journal* of the American Medical Association that a memorial auditorium named in honor of the late Dr Henry Mills Hurd, for many years superintendent of the Johns Hopkins Hospital, is now in construction on the hospital grounds The building, which will seat 200 persons with standing room for an additional 100, will be completed in the fall A part of the equipment will be a device for projecting pictures from underground rather than from the rear Thus the lecturer may illustrate with living models, without their appearing in view of the audience. The Hurd memorial was the gift of Mr George K McGraw.

A committee of university professors is preparing the material for the publication of the "Complete Works" of Lazzaro Spallanzani, which will contain all the writings, published and unpublished, of the great biologist It will not be a "critical edition" but will contain material calculated to show what is due to Spallanzani as regards the priority of scientific observations and discoveries. The first two volumes will be issued on the occasion of the International Congress of Physiology, which will be held in Rome in 1932

The review *Scientia* pays tribute to the memory of its late director, Dr Eugenio Rignano, by founding a prize to be conferred after international competition upon the author of the best essay on "The Evolution of the Notion of Time"

RECENT DEATHS

Dr Arthur Starr Eakle, professor of mineralogy at the University of California, has died in Honolulu at the age of sixty-seven years

Dr. William Jasper Spillman, agricultural economist of the U S Department of Agriculture, died on July 11 He was sixty-seven years old.

Dr Eugene Lyman Fisk, medical director of the Life Extension Institute, New York City, died on July 6 at the age of sixty-four years

The death is announced of Dr Harold E. Bemis, professor of veterinary surgery and obstetrics and dean of the School of Veterinary Medicine of the University of Pennsylvania.

Sir Charles Henry Bedford, of Woking, England, formerly editor of *The Indian Medical Gazette* and professor of chemistry in the Medical Colleges of Calcutta and Lahore, died on July 8 at the age of sixty-five years

Nature reports the death of C T. Heycock, F R.S., Goldsmiths' reader in metallurgy in the University of Cambridge, on June 3, aged seventy-two years; of Mr W. F Denning, authority on meteors and comets, on June 9, aged eighty-two years, and on June 9 of Dr. R C Macfie, author of works on biology, Thomson lecturer in the University of Aberdeen for 1929.

SCIENTIFIC EVENTS

THE ALBERT NATIONAL PARK IN THE CONGO

A CORRESPONDENT of *The Geographical Journal*, London, describes the Parc National Albert of the Kivu District of the Congo, which was created mainly for the protection of the mountain gorilla. It was established by Royal Decree on 21 April, 1925, and consisted of 60,000 acres, including the three volcanoes, Mikeno, Karisimbi and Visoke. The area made a splendid wild-life sanctuary. Its remarkable volcanic structure and conformation gave it a special geological and geographical interest. It possessed a flora of exceptional richness and variety ranging from that of the tropics at the mountain foot to that of the alpine meadow near the snow-line. Its fauna was equally varied and peculiar, especially in its possessing the greatest of the apes and the animal most nearly related to man. Its native inhabitants were a pygmy race unusually primitive and interesting to anthropologists. By a later Decree of 6 May, 1929, the Parc was greatly enlarged and placed under the control of an International Commission. It now consists of 500,000 acres divided into four reserves or sectors. It is forbidden under penalty of fine or imprisonment to pursue, capture or molest any animal within these reserves. It is also forbidden to take or destroy the nests of wild birds, to cut down or remove any uncultivated plant, or to alter in any way the natural surface of the country. To the four reserves comprising the main Parc there have been added certain adjacent territories to serve as buffer zones. The restrictions in these zones are less severe. Hunting by visitors is strictly prohibited in them, but the natives are permitted to use their primitive weapons in order to kill animals for food. The International Commission that controls the Parc consists of eighteen persons, of whom one third are chosen from among the members of foreign institutions. The British representatives on the Commission are Viscount Grey of Fallodon and the Earl of Onslow. The Parc National Albert is therefore an international institution and a very practical example of how different countries can combine in the work of protecting Nature. An important feature in the Parc National Albert is that it is designed not only for the preservation of Nature, but also as a place for scientific study. It is hoped that students from all over the world will use it for biological and other investigations. There are now two great sanctuaries in Africa established by law on that rigid foundation which alone gives hope for their long survival. One is the Kruger National Park of the Transvaal, the other is the Parc National Albert of the Congo.

THE HYGIENIC EXPOSITION IN DRESDEN

THE International Hygienic Exposition, which reopened on May 6, is arranged this year, according to a correspondent of the *Journal* of the American Medical Association, to make a more immediate appeal to the layman. An attempt has been made to avoid unduly technical terms and statements, without yielding anything from the standpoint of clearness and accuracy. An entirely new section "Diagnosis and Treatment" reveals the thoroughness, the complex nature and the heavy responsibilities of the medical profession. The set-up brings out that only the physician, who knows the normal body thoroughly, can recognize and cure pathologic departures from normal. It is the opposite of the exhibit presented last year, which revealed the manifestations of quackery and superstition. The management has enlarged a section that awakened particular interest, namely, habit-forming drugs. The results of morphinism, cocainism and excessive addiction to products bearing nicotine are clearly depicted. In the two first addictions, it is plainly emphasized that addicts are actually ill and must be treated as patients, in the case of nicotine and alcohol addiction that conclusion was avoided. A section termed "health in figures" has the purpose of teaching a correct understanding of medical statistics. With the aid of statistics, sources of error may be exposed that sometimes creep in and disturb a mathematical conception of diseases, thus leading to pessimism whereas actually optimism is in order. Figures showing an apparent increased incidence of certain diseases have often their basis in the fact that new means and methods of diagnosis make possible an earlier and more precise recognition of a disease. Especial interest attaches to the model hospital of eighty rooms, which contains a radium department that has few if any equals. The broad field of industrial hygiene has been completely reorganized. A miniature mine exhibits the large number of arrangements and devices to protect the lives and the health of workmen. The participation of foreign countries this year is gratifying. Austria, Czechoslovakia and France have reorganized their exhibits in a satisfactory manner, having added considerable new material. Several new exhibits have been installed by the Deutsches Hygiene-Museum, constant improvement and modernization are characteristic of this museum.

RESEARCH PROGRAM OF THE ILLINOIS STATE GEOLOGICAL SURVEY

THE Illinois State Geological Survey, by virtue of the action of the State Board of Natural Resources and Conservation, supported by appropriations made by the last General Assembly and Governor Emmerson, is undertaking an extended program of research which will begin with the occurrence of raw mineral materials in the ground and end with industrial research on utilization and marketing. The program recognizes the need of eight lines of endeavor: (1) special projects to furnish information or solve certain problems of current importance, (2) continuing projects that gradually increase the fund of general information regarding the geology, mineral resources and mineral industrial history of the state, (3) fundamental research into the stratigraphy and structure of the geologic systems of strata, (4) fundamental research into the constitution of the various earth materials, with emphasis on those that are basic to industrial development, (5) chemical and physical research on industrial utilization, (6) study of the flow of minerals into and out of the state and of the trends of the industries as affected by discoveries of new resources, new uses, and new or improved methods of processing, (7) provision of information to the general public, the industries and the various departments of state government, and (8) educational extension and dissemination of knowledge concerning the geology of the state accumulated during the past twenty-six years of investigations, for the benefit of the laymen and the science teachers in the public schools.

The State Geological Survey will now comprise a geological resource section of geological specialists in coal, non-fuels, oil and gas, subsurface data, areal geology, engineering geology, sedimentary petrography, stratigraphy and paleontology, a geochemical section of specialists in organic, physical, analytical and industrial chemistry, and a geophysicist in the broader sense, and a mineral economics section. All these will be supported by the necessary stenographic, clerical and editorial staff. Cooperative topographic mapping with the U. S. Geological Survey will continue on the same scale as heretofore, each organization contributing $50,000 per year.

The urgent need for such an organization of the Illinois Geological Survey to carry out effectively the type of program outlined, was recognized by the mineral industries, engineering organizations, business interests and state officials, and particularly is the need for it evident during the present depression. Fairly adequate appropriations amounting to a total of about $470,000 for the biennium were therefore made by the legislature and the governor.

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE eighty-second meeting of the American Chemical Society will be held in Buffalo, New York, from August 30 to September 4. From the tentative program, as given in *Industrial and Engineering Chemistry*, we learn that the registration office at the Hotel Statler will be open on Sunday, August 30, from 4 to 8 p. m., and from 8 a. m. on the following days. At 2 p. m. on Monday there will be a general meeting at Hutchinson High School Auditorium and a symposium under the auspices of the Division of Industrial and Engineering Chemistry on "New Research Tools," under the chairmanship of Dr. Karl T. Compton. Those taking part are expected to include F. G. Cottrell, E. M. Chamot, R. B. Sosman, F. G. Keyes, W. A. Peters, P. K. Frolich, S. Dushman, W. H. Rodebush, C. P. Smyth, D. H. Andrews, G. L. Clark and J. B. Nichols. In the evening at 7 p. m. there will be a subscription dinner, and a reception by the officers of the society, followed by dancing and cards.

Tuesday and Wednesday will be devoted chiefly to divisional meetings and to group dinners and luncheons. On Wednesday evening at 8:30 p. m. Professor Moses Gomberg, of the University of Michigan, will deliver the address of the president on "Valence Variation and Atomic Structure," followed by the initial presentation of the Langmuir award and of the J. F. Schoellkopf Medal. Divisional meetings will be continued on Thursday and inspection trips will be made to the Buffalo Foundry and Machine Company, makers of chemical equipment, and the Dunlop Tire and Rubber Company. There will also be a sightseeing trip to Niagara Falls with transportation by high-speed trolleys. This trip will include an optional visit to the Niagara Falls Power Company's model of Niagara Falls, a trip through the power house on the American side of the Falls and a trip around the Gorge Route. Visitors will assemble about 5:30 for a festival at Victoria Park on the Canadian side, where a picnic supper will be served. The festival will include music, exhibition sports contests and a special illumination of the falls.

On Friday optional inspection trips are planned to the Tonawanda Paper Company, showing some of the largest paper machines in the world, the Consolidated Aircraft Corporation, where the latest commercial models of planes will be exhibited and demonstrated, the Flexlume Corporation, manufacturers of neon signs and illuminated signs, the Curtiss Aeroplane Company, working exclusively on government orders for planes, and Huntley Station of the Buffalo General Electric Company, an unusual steam power plant.

All the divisions will hold sessions at Buffalo and a number of joint meetings and symposia have been planned. The Division of Biological Chemistry will hold a joint session on Tuesday afternoon with the Division of Agricultural and Food Chemistry and on

Wednesday morning with the Division of Medicinal Chemistry on "The Biochemistry of the Fats," with W R Bloor, G S Jamieson, W E Anderson, R J Anderson, W M Sperry and L H Newburgh as speakers On Thursday morning it will take part in a joint symposium on endocrines with the Division of Medicinal Chemistry.

The Division of Chemical Education will hold a joint symposium with the History of Chemistry Division on "The History of Chemical Education in America" This is being planned as a memorial to Edgar Fahs Smith, first chairman of both of these divisions "The History of Chemistry in America from 1820 to 1914" will be divided into four periods, with Lyman C Newell, C A Browne, Harrison Hale and F B Dains as speakers Wednesday afternoon will be devoted to a symposium under the general topic, "Visual Aids in Chemical Education," with papers by invitation only High-school classes everywhere are invited to send exhibits to the divisional meeting at Buffalo

In addition to the symposium on "New Research Tools" the Division of Industrial and Engineering Chemistry will hold a joint meeting with the Divisions of Petroleum Chemistry and Gas and Fuel Chemistry The Division of Petroleum Chemistry will also hold a joint symposium with the Division of Gas and Fuel Chemistry and the Division of Industrial and Engineering Chemistry on the "Utilization of Gaseous Hydrocarbons" Professor Donald B Keyes will act as chairman of this symposium

A symposium on "Kinetics of Reactions" has been arranged by the Division of Physical and Inorganic Chemistry for Tuesday morning, which will probably extend through Tuesday afternoon

The Division of Dye Chemistry expects to hold a three-session meeting divided into three topics one devoted to spectrophotometry, including papers on the various color analyzers and possibly an exhibit of the latest instruments, another on certain theoretical aspects, and the third given over to the usual miscellaneous papers

The divisional officers will meet for breakfast on September 2 with Erle M. Billings presiding and Frank C Whitmore acting as secretary, and the local section officers on September 3 with H T Herrick presiding and with Ellice McDonald as secretary

IN HONOR OF JOHN R FREEMAN

ACCORDING to the *American Engineering Council Bulletin*, the Providence Engineering Society recently gave a testimonial dinner in honor of John R Freeman, which was attended by approximately three hundred engineers Greetings, congratulations and messages of respect were received from engineers and engineering organizations all over the world The speakers were:

Mr Charles T Main, past president of the American Society of Mechanical Engineers, Frank E Winsor, vice-president of the American Society of Civil Engineers, Professor Charles F Scott, past president of the American Institute of Electrical Engineers, Professor Charles W Brown, representing the Geological Society of America, the Rev John Joseph Lynch, of Fordham College, representing the Seismological Society of America, Benjamin Buttolph, vice president of the Manufacturers Mutual Insurance Company, representing the Factory Mutual Fire Insurance Companies, Dr Clarence Barbour, president of Brown University, H E Sawtell, president of the Boston Society of Civil Engineers, Blake R Van Leer, assistant secretary of American Engineering Council, representing the John R Freeman scholars, Chester T Morey, president of the Providence Engineering Society, Walter Humphreys, representing the corporation of the Massachusetts Institute of Technology, Governor Norman S Case, of Rhode Island, and Senator Hebert, who read a message from President Hoover

Professor Charles F Scott, speaking as the representative of the American Engineering Council at the testimonial dinner, said

I have been delegated by the American Institute of Electrical Engineers to bring its greetings to the Providence Engineering Society and to extend its aid in doing honor to Mr Freeman

During your active engineering life, Mr Freeman, you have stood for progress in engineering art and practice, and have labored to make engineering achievement of greater service to mankind During this same half century the electrical engineering group has pioneered a new field of engineering which has contributed a universal power service for relieving the burden of toil, and has created new means of communication, a new tool for intellectual intercourse, and it is therefore particularly fitting that a group so sympathetic with your aims and achievements as a practicing engineer should be privileged to do you honor on this occasion

I am commissioned also to bring the greetings of the American Engineering Council You have been more than a technical, practicing engineer, you have been a ''citizen'' engineer, you have had a high ideal of the engineer in public service It is this ideal which has taken concrete form in the American Engineering Council, the common agency of many engineering societies, with common endeavor These representatives of many technical fields and geographical districts join in rendering engineering service in public affairs

I might, I think, concisely and adequately define American Engineering Council as an organization for putting into effect the public service ideals of John R. Freeman And so it is peculiarly fitting that the council should on this occasion do honor to the man whose ideals and whose acts proclaim him as a notable representative of the highest and broadest type of engineer, and as one who has lived to serve his fellowmen.

SCIENTIFIC NOTES AND NEWS

DURING the business meetings of the Pacific Division of the American Association for the Advancement of Science, held in Pasadena, from June 15 to 20, Professor A O Leuschner, of the University of California, was elected to the presidency of the division for the ensuing year Dr H D Babcock, of the Mount Wilson Observatory, was elected to membership on the Executive Committee in succession to Professor L B Loeb, who is retiring after five years of service Under invitation from the State College of Washington the selection of Pullman, Washington, for the sixteenth annual meeting of the division and its associated societies was approved In all probability the meeting will be held during the week of June 13, 1932

THE provisional program of the James Clerk Maxwell Centenary celebration, to be held at the University of Cambridge on October 1 and 2, has been made public There will be a memorial lecture by Sir J J Thomson, the master of Trinity College, addresses by Professor Planck, Professor Sir Joseph Larmor, Professor Langevin and Sir James Jeans Receptions, a luncheon, conversaziones in the Cavendish Laboratory, an at home by the new Vice-Chancellor and Mrs Spens, and a dinner at Trinity College have also been arranged

THE honorary degree of LL D has been conferred by the University of Glasgow on Sir F G Hopkins, president of the Royal Society, and on Professor C U Ariens Kappers, professor at the Central Institute for Brain Research, Amsterdam

DR HUGH H YOUNG, director of the Brady Institute of Urology of the Johns Hopkins University, has received the degree of doctor of science from Queen's College, Belfast.

DR. J SHELTON HORSLEY, ex-president of the Medical Society of Virginia and of the Virginia Academy of Science, received the honorary degree of LL D from the University of Richmond at its commencement exercises Dr Horsley was formerly professor of the principles of surgery at the Medical College of Virginia.

DR ROSS V PATTERSON, dean of Jefferson Medical College, Philadelphia, and president of the Medical Society of the State of Pennsylvania, received the honorary degree of doctor of science at the dedication of a new group of buildings at La Salle College

THE degree of doctor of science was conferred on the Reverend Dr George H. Richardson, rector of Christ Church, Lead, South Dakota, by Yankton College at its commencement on June 10, in recognition of his work in paleontology.

THE South Africa Medal for 1931 has been awarded to Professor H. B Fantham, of the department of zoology and comparative anatomy in the University of the Witwatersrand, Johannesburg, for his researches on parasitic protozoa, soil protozoa and heredity

AT the recent meeting of the British Institution of Gas Engineers medals were conferred as follows Birmingham Medal, 1931, to Mr. Thomas Hardie, chief engineer of the Gas Light and Coke Company, for his work on behalf of the industry, the H. E Jones London Medal, 1930, to Mr Edward G Stewart, of London, for his paper on "The Functions of Coke Ovens", the Institution's Silver Medal, 1930, to Mr A L Holton, chief engineer, Manchester Gas Corporation, for his paper on "The Utilization of Coke Breeze by the Trefois Process," and the Institution's Bronze Medal, 1930, to Mr S K Hawthorn, Birmingham, for his paper on "Oxide Purification."

DR R W DODGSON, of the British Ministry of Agriculture and Fisheries, Dr C M Yonge, of the Marine Biological Association Laboratory at Plymouth, England, and Dr John Eyre, of Guy's Hospital, London, are to be guests of honor at the annual joint meetings of the Oystergrowers and Dealers Association of North America and the National Shellfisheries Association at Sayville, Long Island, to be held from August 18 to 20 Scientific men, federal and state officials are expected to present papers and reports The results of the investigations conducted for the research committee of the Growers Association, under the direction of Dr H D Pease, of New York, will be shown as technical exhibits at the association's biological field station at West Sayville, Long Island

MR. C E SKINNER, assistant director of engineering of the Westinghouse Electric and Manufacturing Company, has been appointed as the representative of the American Standards Association on the council of the International Standards Association. The International Standards Association is a federation of eighteen national standardizing bodies, its purpose being the systematic exchange of information on standardization work in the different countries and the promotion of uniformity among the various national standards The council is composed of the president of the International Standards Association and six other members, each representing a national standardizing body C Hoenig, chairman of the Swiss national body, is now president of the association, and the six members of the council represent Italy, France, Holland, Russia, Denmark and the United States.

THE following have been elected honorary fellows of New College, University of Oxford: Lord Donoughmore; Dr J B. Leathes, professor of physiology in the University of Sheffield and formerly a scholar of the college; Dr. A E. Taylor, professor of moral philosophy in the University of Edinburgh

DR. ARTHUR W PROETZ, assistant professor of clinical otolaryngology in Washington University School of Medicine, has received the $500 Casselberry prize of the American Laryngological Association for notable work in his field. The award was made at the recent annual meeting of the society in Atlantic City, in recognition of research work by Dr Proetz on sinus diagnosis and treatment This prize was established by the late Dr William E Casselberry, Chicago, to be awarded for outstanding work in laryngology and rhinology

AN oil portrait of Dr Frank C Hammond, who was for twenty years dean of Temple University School of Medicine, Philadelphia, was presented to the school by the class of 1929 at an alumni dinner on June 10

DR C W STILES, of the U S Public Health Service, completed forty years of active government service on June 30, and will go on the retired list on October 1 His address will be from October 1 to June 1, Winter Park, Florida, and from June 1 to October 1, Morristown, New Jersey

COLONEL CHARLES F CRAIG, until recently assistant commandant of the Army Medical Center, Washington, D C, and late director of the Army Medical School, will be retired from the Medical Corps of the army, at his own request, after more than thirty-three years service Colonel Craig has accepted the appointment of professor of tropical medicine at the Medical College of Tulane University, New Orleans, and head of the department of tropical medicine at that university and will take up his duties there about September 15.

THE appointment of Colonel Edward L Munson, Medical Corps, as assistant to Surgeon-General Robert U Patterson, with the rank of brigadier-general, for the four-year period beginning on June 1, has been announced Brigadier-General Munson has been professor of hygiene at the Army Medical School, Washington, D C., and professor of preventive medicine at George Washington University School of Medicine

MR. S. C. SALMON, who has been with the Kansas State College since 1913 and professor of farm crops in that institution since 1917, has resigned and after July 1 will be principal agronomist in the Office of Cereal Crops and Diseases of the U S Department of Agriculture.

MR. HERBERT J. GILKEY, professor of civil engineering at the University of Colorado, has been appointed head of the newly organized department of theoretical and applied mechanics at Iowa State College.

DR RICHARD W LINTON has resigned as assistant professor of bacteriology in the College of Physicians and Surgeons, Columbia University, and is leaving in July for India, where he will take a position in cholera research with the Indian Research Fund Association.

DR J. J GALLOWAY has resigned his position as associate professor of paleontology at Columbia University to accept the chair of professor of geology and paleontology at Indiana University, his alma mater He will continue his studies in micropaleontology in his new position

THE trustees of the estate of John W Sterling have given $1,500,000 to Yale University for the endowment of five additional Sterling professors One is to be allocated in the first instance to Charles Templeman Loram, chairman of the Native Affairs Commission and director of education at Natal, South Africa, who will join the graduate faculty as professor of education, with especial interest in social science, one of the professorships is assigned to Dr James Harvey Rogers, now a member of the faculty and formerly professor of economics at Cornell University and the University of Missouri, one to Dr Edward Sapir, formerly professor of anthropology and linguistics at the University of Chicago, and one to Dr Oystein Ore, now professor of mathematics in the university and formerly of the University of Oslo, Norway The fifth of the new Sterling professors has not yet been named

PROMOTIONS to professorships in the University of Michigan include Dr Ernest Franklin Barker in physics, Dr Peter Olaus Okkelberg in zoology, William Platt Wood in chemical engineering, Arthur Dearth Moore in electrical engineering, Chester Owen Wisler in hydraulic engineering, Allen Firman Sherzer in mechanical engineering, Dr Clifford Conklin Glover in pharmacognosy and Leigh Jarvis Young in silviculture

THE following additions have been made to the staff of the New York State Agricultural Experiment Station at Geneva, effective on or about July 1 Dr M W. Yale, associate in research in bacteriology, A W. Hofer, assistant in research in bacteriology, C D Kelly, technician in bacteriology, Dr A. L. Shuck, associate in research in botany, Dr Mabel Ruttle-Nebel, assistant in research in botany, Dr H. S. Cunningham, associate in research in plant pathology, L. M. Cooley, associate in research in plant pathology, E C Smith, assistant in research in chemistry, and R R Jenkins, assistant in research in vegetable crops In addition, on July 1, Dr C S Pederson was promoted from associate to chief in research in bacteriology, while J C Marquardt and W F Walsh were promoted from assistants in research to associates in research in dairying and chemistry, respectively

Professor William H Hobbs, professor of geology at the University of Michigan, will sail for Europe on August 22 and remain on leave during the fall semester of the next academic year. He will attend the International Geographical Congress in Paris in September as the representative of the university and will participate in the excursion to the Sahara.

Mr Collman S Williams, paleontologist of the American Museum of Natural History, returned on June 23 from Argentina, bringing more than thirty cases of mammal remains of the Eocene period, unearthed in Patagonia

To make a collection of the birds of Trinidad for the Philadelphia Academy of Natural Sciences, H Radclyffe Roberts, of Villa Nova, George R Clark, of Cynwyd, and W Wedgwood Bowen, assistant curator of birds at the academy and leader of the expedition, have sailed for that island They will spend three months exploring the tropical forests

Mr J R Swallen, of the Grass Herbarium, U S Department of Agriculture, has returned from a three months' trip to Texas and northeastern Mexico The object of the field-work was to study and collect the grasses of the region Especial attention was given to the distribution of species in the border region of both countries

Dr Herman Prinz, professor of pharmacology in the Medical School of the University of Pennsylvania, lectured from July 10 to 15 at the University of Frankfurt

Dr Alexander von Lichtenberg, of Berlin, gave recently a lecture before the Royal Society of Medicine, London

The James A Patten lecture in bacteriology was given at Northwestern University Medical School by Dr Arthur Isaac Kendall, of the department of research bacteriology, on July 22 The title of the lecture was "Observations upon the Filterability of Bacteria, including a Filterable Organism Obtained from Cases of Influenza"

Princeton University announces that provision has been made for work toward advanced degrees in mathematical physics. During the fall term of this year graduate courses in this field will be offered by Professors E. P Adams, J. vonNeumann, E P. Wigner, E U Condon and H. P Robertson Dr P. A M Dirac, of Cambridge, will lecture on the relativistic formulation of quantum mechanics up to the Christmas vacation

During the session of 1930–1931, the Mayo Foundation Chapter has held five regular meetings The list of speakers and their subjects are Professor D. E Minnich, department of zoology, University of Minnesota, "The Mine of an Insect", Professor A E Jenks, University of Minnesota, "Excavating American Prehistoric Culture—the Unique Art of Mimbres Pottery", Dr J H Mathews, University of Wisconsin, "Scientific Methods in the Detection of Crime", Professor Ralph Linton, "The Life of the Madagascar Native", Dr Walter M Boothby, "Concepts of Relativity as Applied to Social Bridge" The officers for the coming year are *President,* Dr E S Judd, *Vice-president,* Dr A E Osterberg, and *Secretary,* Dr J L Bollman

The International Congress on Radiology meets at Paris from July 26 to 31 Mme Marie Curie, co-discoverer of radium, is honorary president of the congress She will be presented with the gold medal of the American College of Radiology Standardization of such a unit of measurement is one of the principal problems to come before the meeting Dr Lauriston Taylor, of the Bureau of Standards, and Dr Edwin C Ernst, of St Louis, will represent the Radiological Society of North America, and will be the United States members on the committee, which will consider this matter of standardization Other delegates from the United States to the congress are Dr Albert Soiland, of Los Angeles, representing the American Medical Association, Dr Benjamin Orndoff, of Chicago, representing the American College of Radiology, Dr George Grier, of Pittsburgh, representing the American Radium Society, and Dr. George E Pfahler, of the University of Pennsylvania, representing the American Rontgen Ray Society

The late Samuel Betts, patent lawyer, by his will left $426,658 to Yale University Of this amount the residuary estate, $276,533, was left to Yale College, $50,000 to the Law School to provide books on patent law, a like sum to the Art School for use in collecting representative works by Yale graduates or other Americans distinguished in the arts, and $50,000 to the Yale University Library $100,000 is left to the Kingsley Trust Association, otherwise known as the Scroll and Key Society, and $5,000 to the Yale alumni fund through the class of 1875.

MR WILLIAM K VANDERBILT'S yacht *Alva*, left Northport, Long Island, on June 7, for a voyage of exploration around the world during which specimens of marine life will be collected Special equipment has been installed on the *Alva* for collecting and preserving the marine specimens which will be brought to the Vanderbilt Marine Museum at Centerport, where specimens gathered during the past twenty-five years are to be found The trip of the *Alva*, which will take several months, will include the Panama Canal, Galapagos Islands, the Society Islands, Samoa Islands, the Fijis, New Hebrides, New Caledonia, Australia, the south coast of New Guinea, the islands of Flores, Java, Sumatra, Singapore, Burma, Ceylon, the Red Sea, the Mediterranean and then home by the Canaries and the Windward Islands

DISCUSSION

THE DECLINE IN THE AVERAGE LENGTH OF LIFE

IN SCIENCE for July 26, 1929,[1] H C Forsyth discussed "The Decline in the Average Length of Life" and concluded that "the average length of life—or at least the expectation from age 10—is already going down It will be noted that the expectation from age 45 to 50 is the lowest of which we have any record—and is still going down, not up" In a letter in SCIENCE for September 13, 1929,[2] Mr J T Ryan criticizes Professor Forsyth's conclusions as unjustified He explains the apparent increased mortality at advanced ages on the ground that the reduction in infant mortality and in deaths from communicable diseases (later specifying croup, diphtheria and smallpox) has postponed death in those who were thus saved He concludes that these prolonged lives are usually sustained by diminished vitality and would therefore lower the average general health of the community The effect of this lowered average general health of the community would manifest itself later by an increased death-rate at early advanced ages

Apart from the question of the influence of these lives saved in early life on the lowering of the average general health of the community, which is debatable, there is a fallacy in the bases for Mr Ryan's conclusions to which I desire to call attention

Professor Forsyth's figures indicate an increased death-rate at advanced ages which is remarkably concentrated at age 70, although it extends back as far as age 40 The last statistics which Professor Forsyth quotes are for the year 1927 A man dying in 1927 at age 40 would have been born in 1887 The period of his infancy (first 2 years, according to pediatricians; 7 years, Oxford Dictionary) would have extended, using the larger figure, through part of the year 1894.

Fatal forms of croup are, practically without exception, diphtheria. Although diphtheria antitoxin was discovered by v Behring in 1892, its practical production was first made possible by the work of Roux, reported in 1894 The influence of its general use, even in Boston, where its exhibition—notably in the highly efficient massive doses—was practiced earlier than elsewhere throughout the country, began to appear in the death-rate from the disease in 1899 Since the maximum mortality from diphtheria occurs at ages two to five it is evident that few if any persons dying at age 40 in 1927 could have been saved by antitoxin from diphtheria during the early years of their lives Diphtheria prophylaxis with toxin-antitoxin or toxoid has been carried out only in recent years

There is little evidence that the practice of vaccination had any greater influence on the mortality rate in the period 1887–1927 than during the preceding generation Scarlet fever antitoxin was introduced in 1923 The use of convalescent serum in measles and anterior poliomyelitis is of recent development The mortality from whooping-cough still remains high

Finally, diarrheal diseases, which were the most potent killing agencies among the young, continued to be active up to the decade 1910–20 The growing practice of Pasteurization of milk then began to produce the most marked lowering of the death-rate among infants of any known prophylactic or therapeutic treatment for any disease The man of 40, dying in 1927, however, could not have been helped in infancy by this procedure

It is clear that the lowering of infant mortality or that due to the communicable diseases, upon which Mr. Ryan bases his strictures on Professor Forsyth's conclusions, could have had little or no influence on the death-rates of individuals age 40 in the year 1927, with which Professor Forsyth's study deals If this is true for the man dying at 40 years of age in 1927, it is of course much more true for the more advanced ages and for the years preceding 1927

If Mr. Ryan's thesis—that the lives saved in infancy will be associated with a lowered average general health at later ages and a resulting higher mortality at early advanced ages—is correct, the outlook for the future is even more serious than Professor Forsyth's paper indicated

TIMOTHY LEARY

---

[1] SCIENCE, 70: 85, 1929

[2] SCIENCE, 70: 260, 1929.

NEW PALEONTOLOGIC EVIDENCE ON THE AGE OF THE METAMORPHIC SERIES OF NORTHEASTERN WASHINGTON

THE three northeastern counties of the state of Washington—Ferry, Stevens and Pend Oreille—are covered in the main by outcrops of metamorphosed sedimentary rocks The outcrops are in isolated fault block hills, and stratigraphic relationships are obscure Weaver, in his report on the mineral resources of Stevens County,[1] divides the sediments into twenty-one formations, all included in the Stevens series This is a thick series of alternating argillites and quartzites with lenticular beds of limestone Weaver states that "the several divisions or stratigraphic members which have been grouped under the Stevens series are entirely nonfossiliferous"[2] On the basis of possible lateral continuity with the Pend Oreille series of British Columbia he states that the upper members of the Stevens series are of the same age, possibly upper Paleozoic, and that the lower members of the Stevens series may represent the lower and middle Paleozoic

Very little has been added since to this statement of age Previously, Shedd had stated that the only locality in the limestones of eastern Washington where he knew of fossils being found was in the undifferentiated limestones north and east of Springdale.[3] The fossils appeared to be corals Some crinoid stem segments have been found near Republic, Ferry County From the coral and crinoid remains and from the apparent relationships of the Stevens series with beds in British Columbia, the age of the Stevens series has been given as Carboniferous, at least in part

Dr Culver and Dr Jones, of the State College of Washington, have brought in some additional fossils from the Stevens series, and these give definite evidence of the age of the deposits One collection was blasted from the undifferentiated limestone six miles north of Chewelah, Stevens County The limestone is reddish in color, dense, sandy, and bears thin lenses of impure argillite Specimens of *Kutorgina cingulata* (Billings) are abundant and a few fragments of free cheeks of trilobites occur *K cingulata* is confined to the Lower Cambrian in its numerous occurrences, so it is certain that this portion of the Stevens series is Lower Cambrian in age

The Mission argillite occurs two miles east of Daisy, Stevens County. Two specimens of a pelecypod were found there These appear to belong to the genus *Paleoneilo*, which is most common in Devonian rocks, but which ranges to Triassic. Some graptolites of the *Monograptus* type were found in the Mission argillite north of Colville, Stevens County. *Monograptus* is confined to Silurian and Devonian rocks, and this occurrence, together with the occurrence of *Paleoneilo*, indicates Devonian age of the Mission argillite A coral from the undifferentiated limestone north of Colville appears to be a *Favosites* Some *Fusulina*-like foraminifera were found in the same area

It seems quite possible that the metamorphic series of northeastern Washington represents most of the Paleozoic periods, and that careful search in the area will disclose definitive fossils in most of the members of the Stevens series

C C BRANSON

BROWN UNIVERSITY

---

[1] C E. Weaver, Washington Geol Surv, *Bull* No. 20, 1920

[2] *Idem*, p 52

[3] Solon Shedd, Washington Geol Surv., *Bull.* No. 4, p 123, 1914.

THE BASAL-METABOLIC RATES OF VEGETARIANS

THE work of Benedict and Roth[1] published in 1913 indicated that there is little, if any, difference between the basal-metabolic rates of vegetarians and non-vegetarians.

Consistent sub-normal results for the basal-metabolic rates of long-time vegetarians led the writers of this paper to present the following data.

The group chosen for intensive study consisted of girls—nurses in training at a vegetarian sanitarium—between the ages of eighteen and twenty-five, and living under uniform conditions of diet, work and general environment No subjects who were more than 10 per cent over or under weight, or who showed symptoms of poor health or other abnormality, were included in the group The determinations were all made with the same apparatus and at the same time of day, before the girls left their beds in the morning The Du Bois standards of normality were used as the basis of comparison

Five girls were classed as life-long vegetarians, having never eaten meat of any kind in their lives. Their average basal-metabolic rate was 14 per cent. below the normal of Du Bois Ten girls were classed as long-time vegetarians, having been non-meat-eaters for five years or more Their average basal-metabolic rate was 12 per cent below normal.

As a check on this work, the basal-metabolic rates of twenty-six non-vegetarian girls were determined, with the same apparatus and under conditions as nearly parallel as possible. Their average basal-metabolic rate was 4 per cent. below normal.

Comparison of these results with the basal-metabolic rates of short-time vegetarians seems to show that a long period of vegetarianism is necessary if the rate is to be noticeably reduced.

---

[1] *Jour. Biol. Chem.*, 20: 231, 1913.

A fuller account of this work will appear elsewhere.

GLEN WAKEHAM
LOUIS A. HANSEN
UNIVERSITY OF COLORADO

REACTION OF THE CONTENTS OF TRICHINELLA SPIRALIS CYSTS

THE late Dr. Allen J. Smith, former professor of pathology in the University of Pennsylvania, added crushed *Trichinella spiralis* (Owen) cysts from a human muscle to ordinary agar medium tinted blue with litmus indicator. The cysts were found in a portion of the pectoral muscles of a badly infested human cadaver (U. of P. Path. Mus. 37) in the dissecting room. There resulted a pink color indicating an acid reaction. He suggested to the writer, in 1925, to carry on this unpublished work and endeavor to determine the reaction of the contents of such cysts in rats.

Feeding rats with trichinosed meat, secured through the late Dr. B. H. Ransom, of the Bureau of Animal Industry, Washington, heavy infestation was secured in one month. It was deemed advisable to allow three months to pass before beginning work on them. Numerous cysts were found after lapse of that period, the regions of highest infestation being the diaphragm and intercostal muscles. The nematode larvae were found singly in the cysts, which measured 0.33 x 0.16 mm. The rats became fat and exhibited all the signs of general well-being.

Upon ordinary agar medium, having phenolphthalein indicator over the surface, were placed twelve capsules. They were then crushed between two needle scalpels and it was observed that the indicator turned pink—showing the presence of an alkali. This was repeated with the same result.

To the contents of other cysts crushed on agar Rosolic acid indicator was added. This resulted in a pink color, after a half-day well protected from the air. This acid indicator has a pH range of 6.9–8.

A series of Clark and Lub's sulfonphthalein dibasic acids were employed as a comparator set to determine the pH. This resulted in failure. The indicators are too delicate to enable one to note color changes under the microscope. Crushed cysts on a white china dissecting plate and on plaster of Paris impregnated with phenolphthalein indicator gave a pink color in four out of fourteen. Allowing cysts to dry, crushing them, and then adding indicator, resulted in no change.

It is evident that in order to determine the contents of *Trichinella spiralis* cysts it is not feasible to use the colorimetric method. Dr. Smith noted an acid reaction. *However, these results seem to point to the* presence of an alkalin substance. To check this one would need to determine if the contents would form a definite crystal that has a polarizing color reaction distinctive for some base. Some investigator with apparatus available could employ Barber's pipettes on a micro-dissecting apparatus to draw out the fluid to test. Or, better to employ an electrometric potentiometer with glass needle electrodes as has been done in entering single cells. Electrometrically one can show the exact pH, one characteristic, and a step further in determining the contents of Trichinella cysts. Its importance lies in the fact that it is not known what enables larvae to remain viable in this infective stage up to twelve years.

W. P. N. CANAVAN
MEDICAL LABORATORY,
UNIVERSITY OF OKLAHOMA

SEX IN THE LOUISIANA OYSTER, OSTREA VIRGINICA

As far as the writer is aware, it has been stated by every worker in the field that the Eastern American oyster, *Ostrea virginica* Gmelin, is a dioecious species. The oyster of the Gulf Coast is considered to be identical with the Atlantic Coast form. A study of sex in the common oyster of the Louisiana coast made during 1929 and 1930 indicates, however, that although the sexes of this animal are usually morphologically separate, the oyster is regularly a protandrous hermaphrodite.

Approximately 1,000 individuals were carefully examined during the spawning season with reference to sex, size and position in relation to other oysters. Smears of the gonad of each, stained with eosin and iodine, were used in determining sex. Oysters whose gonads were destroyed by bucephalus or which contained no typical ripe sexual products were discarded, together with other oysters growing in the same cluster.

The sexes were found to be present in almost equal numbers, 371 ♂ to 373 ♀. When the ratio of the sexes was examined in relation to size, however, a striking fluctuation appeared. Of oysters 40 mm or less in body length, there were 220 ♂ to 58 ♀, while of oysters over 40 mm in length there were 151 ♂ to 315 ♀. As an even clearer illustration of this reversal, of oysters 20 mm or less in length, there were 50 ♂ to 5 ♀, while of oysters over 80 mm in length there were 7 ♂ *to* 48 ♀. These figures would seem to the writer to indicate that individuals of *O. virginica* first become sexually mature as males, and that with increase in size there may be a change of sex to female. This sex-metamorphosis would seem usually to occur at a body length of about 40 mm.

Further data, as given below, indicate that under certain conditions this sex-metamorphosis *does not* occur, and incidentally show that we are not here dealing simply with a differential growth rate or death rate for the two sexes

Among oysters over 40 mm in length, and growing singly, that is, not in the near neighborhood of other oysters, there were 34 ♂ to 131 ♀ Among oysters of length similar to the above, which, however, were growing in compact clusters of two or more individuals, so that the valve margins of the associated oysters were less than 40 mm apart, there were 85 ♂ to 82 ♀ Among oysters of this same length, growing in clusters, but whose valve margins were separated from those of their neighbors by 40 mm or more, there were 27 ♂ to 46 ♀ The clusters of closely associated individuals were almost always composed of oysters of dissimilar sex Thus, the close association of large oysters seems to cause some members of the group to be male, while individuals of this same size, if growing singly, are almost all females The figures given above dealing with clusters of less closely associated individuals indicate that the likelihood of large oysters being male decreases rapidly with increasing distance from associates

Small oysters, no matter what their position relationships to other oysters, are almost always males

Nine morphologically hermaphroditic individuals, irregularly placed as to size- and position-relationships, were found, an incidence of about 1 per cent.

The experimental control of the sex of oysters has been accidentally accomplished on a large scale in Louisiana, in the following manner

Oysters growing in natural clusters are usually more than half of them males. The oyster planters of the state often break up these clusters and re-bed the individuals singly to grow for market When these single, bedded oysters, presumably over half of them males at the time of replanting, are taken up during the next year's spawning season, almost every one is found to be a female

A more detailed description and discussion of the data obtained is in preparation •

M D. BURKENROAD

LOUISIANA STATE DEPARTMENT OF
CONSERVATION, IN COOPERATION WITH
DEPARTMENT OF ZOOLOGY, TULANE
UNIVERSITY

CORRECTION ON PSYLLID-YELLOWS

IN the issue of SCIENCE for December 20, 1929 (lxx, 1825), on page 615, there was an article published on "Transmission Studies with the New Psyllid-yellows Disease of Solanaceous Plants" This disease was previously described by Dr B L Richards, of the Utah Agricultural Experiment Station, who first associated the Psyllid insect with the trouble on potatoes The report on the damage to the early potato crop, and the description of the symptoms on potatoes was likewise made by the same investigator The work reported on in the article was based on Dr Richards's first description and association of the insect with the disease

In order to clear the confusion that exists on the original association of the Psyllid with the disease, this explanation is deemed highly necessary

A M BINKLEY

COLORADO AGRICULTURAL COLLEGE

SCIENTIFIC BOOKS

Plant Life through the Ages A Geological and Botanical Retrospect By A C SEWARD 601 pp. 140 figs including 9 reconstructions of ancient landscapes drawn by Edward Vulliamy Macmillan Co, New York, 1931

THIS book is written for the layman as well as for the student of botany and geology, and in the words of the author is designed "to illustrate the nature of the documents from which geologists have compiled a history of the earth, or at least such scraps of history as can be written from the material that is available: to give some account of the methods employed in the interpretation of the documents and to present in language that is not unnecessarily technical a summary of the more interesting results obtained from the records of the rocks which throw light on the development of the plant world."

It is charmingly written and has a distinct literary flavor, and will undoubtedly enable many to obtain a comprehensive view of a wholly unsuspected past of the plant world The special student will find it equally useful because very little that has been contributed to this and cognate sciences in late years has escaped the author's intellectual curiosity, as is attested by the very useful bibliography.

The general plan leads the reader from an introductory consideration of the elementary facts of historical geology, the manner of preservation of fossil plants, and the classification of plants, through a brief discussion of pre-Cambrian life and that of the earlier Paleozoic (Cambrian, Ordovician and Silurian periods), to a more detailed account of the earliest fairly well-known land plants of the Devonian. The later Paleozoic, appropriately enough since the floras in their variety and our knowledge of them is so much more complete, has three chapters devoted to its consideration There follow chapters devoted to the Triassic, Jurassic, Cretaceous, Tertiary and Quaternary, and a final chapter discussing the more general questions growing out of the story related in the preceding part of the book

Naturally in such a limited compass much must be omitted—a bare catalogue would occupy much more space—and Professor Seward has had to select, partly with a view to continuity in the narration This is done with a skill and a lack of dogmatism which is in pleasing contrast to some of his more youthful work The illustrations also are one of the noteworthy features of the book Tables of geological and geographical distribution, together with maps—both distributional and paleogeographic—are added to the chapters devoted to the botanically more important periods In all the reader is furnished with an easy and satisfactory guide which will enable him to delve as deeply as he may wish into the technical literature Nothing that has been written on the subject approaches the present book as an introduction to professional study in paleobotany, especially in its broader and more cultural aspects

A few slips have been noted, such as calling the Black Hills a spur of the Rocky Mountains, the locating of Staten Island off the west coast of North America, the "salt lakes in the Newark series" and the placing of the Albian stage first in the Upper and then in the Lower Cretaceous, but it is perhaps carping to mention such very minor blemishes in a work which is so exceedingly well done as a whole

There are a number of geological concepts that are taken for granted which are open to question, particularly in the section devoted to geological cycles—a belief that has appealed to many geologists, but which is wholly subjective Nor are the folding of strata and the elevation of mountains interchangeable terms There is also a lack of appreciation of continental sedimentation, other than lacustrine, particularly in connection with the discussions of the Old Red sandstone, the Gondwanas, Triassic, Wealden, etc, and a too easy acceptance of red beds as indicative of arid climates Although he does not accept it, the author might be said to flirt with the Wegener hypothesis, although, as has been frequently pointed out, its acceptance raises more difficulties—distributional and climatic, not to mention geophysical—than it solves.

It may well be doubted if there is the implied change in floras at the Paleozoic-Mesozoic boundary, and although it is perhaps wholly a matter of opinion the reviewer has grave doubts regarding the relatively late appearance of the first land floras Paleobotanists are at present in about the state of mind on this question as were paleozoologists a couple of generations ago regarding the similar question of the time of appearance of marine life

Despite these criticisms, the verdict must go to the author, for they are more than counterbalanced by the pleasing character and meritorious qualities of the book as a whole

EDWARD W BERRY

JOHNS HOPKINS UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN INEXPENSIVE LIGHT SOURCE FOR A PORTABLE MICROSCOPE

WE have devised an inexpensive portable light source for a high and low power portable microscope There are certain obvious situations in which this apparatus is of value (a) During a surgical operation fresh frozen microscopic sections made from tissue removed while the operative procedure is in progress can be passed around among spectators and students in an amphitheater and give a vivid picture of the disease which the surgeon is trying to combat (b) The apparatus furthermore lends itself admirably to teaching histology, pathology or biology, when occasion arises requiring a demonstration to a class of a certain feature or features *in* a microscopic preparation. (c) There is also possible application for the apparatus when one is doing blood or spinal fluid cell counts in a home (d) Botanists and entomologists in field work have a need for such an apparatus

The essential features of the apparatus are a small portable microscope, such as the Spencer Lens Company demonstrating microscope, No 96, and a light source (Fig 1a) The light source is composed of a lamp and reflector from a flash light, a hinge-topped metal case, containing two standard dry cells and a rheostat switch which allows two different degrees of light, bright and dim (Fig 1b)

The lamp house is fastened to the base of the microscope with two screw clamps (Fig 1a) The flash light lamp is dissembled from the usual tubular handle and the outer collar with screw threads is soldered to the hinged lid of the lamp house When the lid is closed, the center of the lamp makes an electrical connection, with a base plug by spring contact (Fig 1b) The dry cells are held in place by spring contact carriers which convey electrical energy to the rheostat switch. Resistance for this switch is formed by about 3 feet of fine annealed wire wrapped on a wood pulp spindle and insulated from the metal housing by sheet mica The inside of the lamp housing is lined with paste board as an insulating medium

Parts of the apparatus that will deteriorate can be bought in any electrical goods store

The apparatus with the self-contained light source

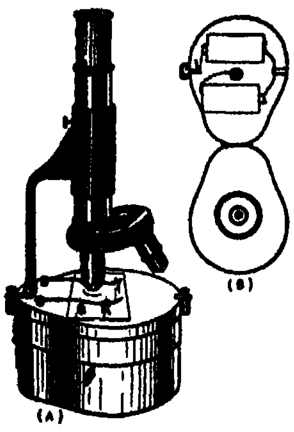


Fig 1a Assembled apparatus with the microscope in position on the lamp house The hinge for the cover and screw clamp holding it in position are illustrated The switch key is revealed well down on the side of the lamp house

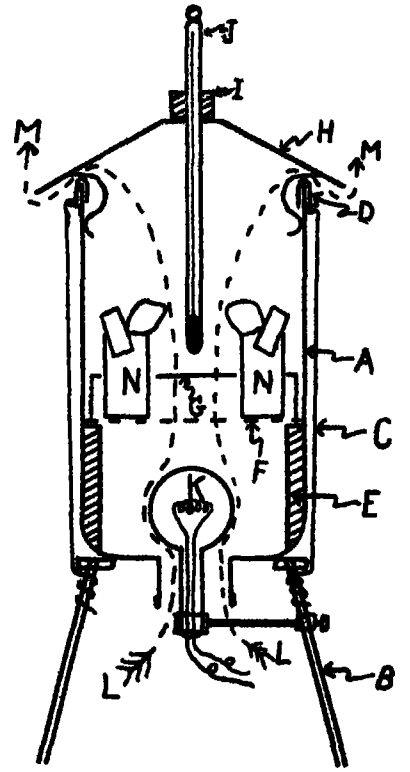
Fig 1b A diagram illustrating the internal construction of the apparatus. In this sketch the lamp house is opened with the hinged top lid turned down The flash light and its center contact are shown on the inside of the lid In the base are the two standard dry cells with their electrical connections and contact clamps with the rheostat switch and center spring contact for completion of the electrical circuit to the lamp

is especially useful because one can view microscopic sections from any position in a room or teaching amphitheater regardless of relationship to window or other light source

Harold D Caylor
Truman E Caylor

Bluffton, Indiana

APPARATUS FOR RAPID DRYING OF SOLUTIONS



In determining the solubility of strontium nitrate, samples of the solution were dried in ordinary weighing bottles As the water evaporated off, a crust was formed over the top which cut down materially the rate of evaporation Splashing resulted when heated in an oven at 100° C At 70° in a closed electric drying oven as long a time as two weeks was required to dry a sample An electric oven with circulating air not being available, the simple apparatus shown in the figure was devised It consisted of material found in any laboratory A was a 4 litre wide mouth salt bottle The bottom was removed by placing sulfuric acid in it to a depth of one centimeter and adding a little water The heat developed broke the bottom out It was inverted on tripod B and firmly held in place by means of four copper guy wires C having hooks made of bent nails at D An annular ring of plaster of Paris was constructed at E using a cylinder of thin sheet aluminium to hold it in place A wire gauze F was placed over the plaster to support the bottles NN. A frame of copper wire G was placed 1 cm above F This kept the bottles from tipping over The wire gauze permitted a free circulation of air through the apparatus The roof H was made of a piece of a tin can There was a space of one cm between the top of the bottle and the roof to permit the exit of air. It extended far enough beyond the sides of the bottle to prevent the access of dust I was a rubber stopper supporting the thermometer J K was an electric light bulb supported at such a height that air could pass freely through the mouth of the bottle. Smoke from a lighted cigarette followed the path indicated by the dotted lines L–M A 150 watt Mazda lamp maintained a temperature of 110° C, a 100 watt lamp, 70° C. At the latter temperature, 15 ml samples of a 40 per cent solution of strontium nitrate (approximately saturated at room temperature) evaporated to dryness in 24 hours. This compares with the two week period in the closed oven.

A narrow strip of filter paper placed in the solution and extending above the surface of the solution facilitates evaporation without splashing. It, of course, should be dried, before being weighed with the empty bottle, in the same manner as the evaporated sample is dried before the final weighing.

Various alterations suggest themselves. A heating coil supported on a mica frame in the mouth of the bottle can be substituted for the lamp. This gives a more uniform temperature distribution. Different materials might be used in the construction Dried air might be passed through the apparatus This would be advisable if working at room temperatures However, at 70° C the difference between the moisture holding capacity of the air and the actual moisture content of the air of the room is so large that drying the air would hasten the evaporation only slightly.

Warren W Ewing

Lehigh University

SPECIAL ARTICLES

THERMOELECTROMOTIVE FORCES PRODUCED BY A MAGNETIC FIELD

In studying the effects of mechanical strain and of magnetization on the thermoelectric qualities of metals, Sir William Thomson[1] saw, with characteristic insight, that these two agents affecting thermal emfs were only special cases of a more general condition He says, "Physical agencies having directed attributes and depending (as all physical agencies we know of except gravitation appear to do) on particular qualities of the substance occupying the space across or in which they are exerted, are transmitted or permitted with different degrees of facility in different directions if the substance is crystalline" Continuing, he enlarges upon this point of view and says, "Another very general principle is, that any directional agency applied to a substance may give it different capacities in different directions for all others"

The interpretation to be put upon these statements appears to be something like this, suppose two pieces of the same metal as in Fig 1 are joined at A If AB shows properties along its length different from those along AC, they will serve as a thermocouple For instance, if AB is crystalline with its axis extended along the length and AC has the same structure cross-wise, then if AB conducts heat, electricity or any other agent along its length differently from what AC does, these two elements will serve as a thermocouple, even though they are the same chemically

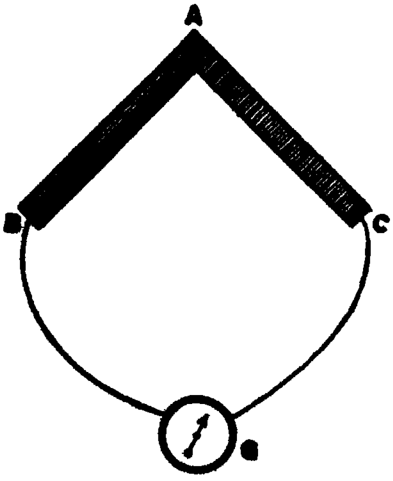


Fig 1

By any means whatsoever, therefore, if we can give to AB and AC different structures so that they behave differently when placed in the path of some physical agent, we shall be able to find a thermal emf set up between the two elements Either by stretching or by magnetizing a substance we accomplish just this effect Thus we find a thermal emf between a stretched and an unstretched portion of a conductor[2] We also discover a thermal emf between a permanently magnetized and an unmagnetized section of the same piece of ferromagnetic wire[3]

A variation of this is shown in Fig 2 where a continuous iron or nickel wire is bent into a U-shaped form and placed between the poles of an electromagnet Let one bend of the wire B be kept at the temperature of steam while the other F is maintained at freezing temperature When the electromagnet is excited an emf occurs and a deflection of the galvanometer ensues One may look upon this arrangement of the thermocouple as a condition in which the two elements consist of longitudinally and transversely magnetized portions While the transversely magnetized sections, due to the very large demagnetizing factor, are not so strongly magnetized as the longitudinally magnetized portion, yet there is developed in each element a structure different from that of the other They may, therefore, serve as a thermocouple This was all clearly set forth by Sir

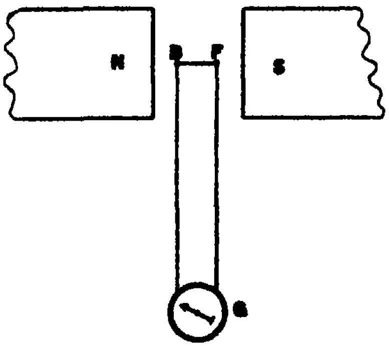


Fig 2

---

[1] Mathematical and Physical Papers, 2. 267

[2] *Phys. Rev.*, 12· 248, 1918.

[3] *Math. and Phys. Papers*, 2· 286

William Thomson in 1856 and has been theoretically discussed by Bridgman[4]

Iron and nickel wires, both annealed and unannealed, have been studied in this laboratory by Wm. Ross His *arrangement of apparatus was that shown* in Fig 2 This work will appear shortly giving the details of the work A modification is now being carried out by Stewart Seass in which the section BF of the iron and nickel wires is transversely magnetized by a solenoid as in Fig 3 As was to be expected the direction of the current is opposite to that found by Ross In the preliminary experiments by Seass it appears that if the wire is transversely magnetized all along the portion containing the junctions B and F, as shown in Fig 4, little or no emf is set up between B and F *Structurally all parts of the wire* are the same, and therefore no emfs are developed This is an important point

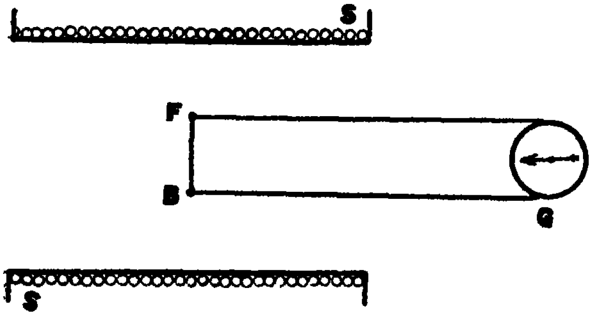


FIG 3

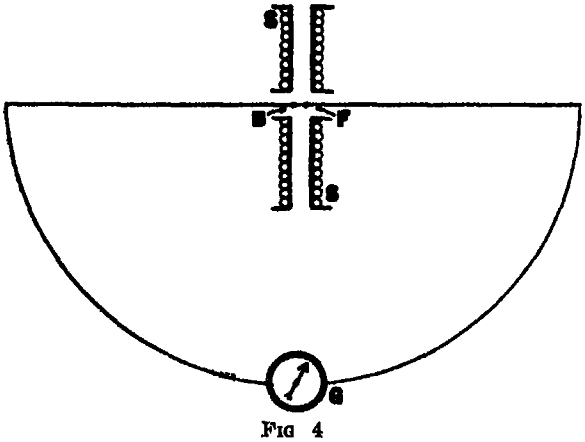


FIG 4

In 1886 Ettingshausen and Nernst,[5] in studying the thermomagnetic effects in bismuth, came upon what they considered a new effect. If a plate of bismuth is heated at one end and kept cool at the other, as shown in Fig 5, a magnetic field normal to the plate and to the direction of heat flow, sets up a longitudinal emf between the points B and F This has been called the thermomagnetic longitudinal potential difference

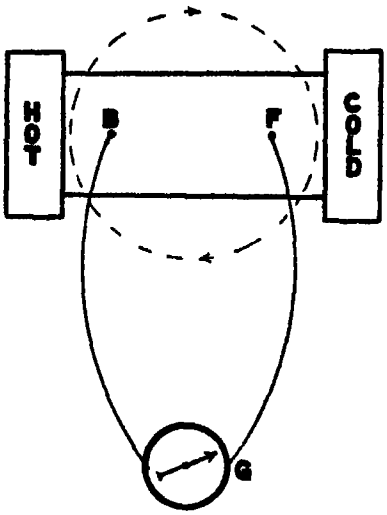


FIG 5

If *one regards carefully* the disposition of the leads from the points B and F to the galvanometer, it will be seen that the Ettingshausen-Nernst effect appears to be a phase of the effect discovered by Thomson, a quarter of a century earlier

Thomson's point of view gives some reason for the emf development in his discovery An explanation is not so apparent when one considers the problem from the standpoint of thermomagnetic longitudinal potential difference It would seem to the writer that this relation between Thomson's discovery and the later one by Ettingshausen and Nernst had not been sufficiently emphasized in the work which has been done on this subject In the papers bearing upon the thermomagnetic longitudinal potential difference there seem to be a great many discrepancies Little or no attention has been paid to the way in which the leads *have been carried from B and F to the galvanometer* This is highly important and accounts for many of the discrepancies between various investigators If there are two distinct effects present, at least one thing is very apparent, the majority of those who have studied the so-called Ettingshausen-Nernst effect have hopelessly confused it with the effect found by Thomson

From whatever point of view one takes this phenomenon there appear to be several factors which enter to produce the resultant emf This is a field which needs a great deal of careful investigation, both from the experimental and the theoretical sides As Campbell[6] says, it is "a vast and fascinating domain, wherein dwell some of the mysteries of matter"

---

[4] *Phys Rev*, 31 221, 1928

[5] *Wiedemann's Annalen*, 29 343, 1886 *Journal de Physique*, 6: 292, 1887

[6] "Galvanomagnetic and Thermomagnetic Effects," p v

S R WILLIAMS
FAYERWEATHER LABORATORY OF PHYSICS,
AMHERST COLLEGE

THE PRODUCTION OF DENTAL CARIES IN RATS FED AN ADEQUATE DIET

ONE of the difficulties encountered by those who have been engaged in dental research has been the production of caries in experimental animals In spite of the fact that diets have been fed known to be deficient in one or more of the dietary factors considered essential for normal dental development, there has been a striking absence of caries This fact alone is impressive and suggests strongly a lack of correlation between the adequacy of the diet from a chemical point of view and the tendency of the diet to produce dental decay

In a study made with rats on the effect of diet on dental development, we were surprised to find caries present in the normal control animals that were receiving the stock ration used in our laboratory This ration (yellow corn 60, whole milk powder 30, linseed meal 6, alfalfa meal 3, sodium chloride 1) has given excellent results over a period of three years and is believed to be adequate for normal dental development and dental maintenance In contrast to this, groups of rats receiving diets characterized by a high oatmeal, low calcium and low vitamin content, gave no indications whatsoever of dental decay, even though the dental structure was relatively soft When oatmeal was substituted for cornmeal in the stock ration, caries failed to develop Apparently, then, the cornmeal was responsible for the decay of the teeth

In making periodic examinations of the teeth, it was observed that impactions of cornmeal particles occurred usually in the lower molars This was followed in a few weeks by the formation of a small cavity which encouraged more impactions and subsequently more extensive decay In many cases a complete destruction of one or more of the lower molars has been observed The upper molars were rarely involved and then to a much lesser degree than the lowers

The tendency for cornmeal to become impacted has been found to be primarily a function of the size of the particle Cornmeal passing through a sixty-mesh screen appeared to have little or no tendency to become lodged in the crevices of the molars Accordingly, when a group of rats received the stock ration containing cornmeal of this degree of fineness, there was no evidence of decay at six months Another group receiving cornmeal that passed through a forty-mesh screen showed slight decay at three months, and at six months the crowns of the central molar teeth were destroyed In the case of the rats which received the fairly coarse meal as supplied by a milling concern, caries was initiated at about eight weeks and at six months practically all the lower molars were involved in extensive decay

Attempts to prevent decay of the teeth by the addition of cod-liver oil or orange juice, supplying liberal amounts of vitamins A, D and C, or by fortifying the ration with calcium carbonate or tricalcium phosphate have been of no avail In view of these results it is difficult to accept the theory that dental caries is due primarily to a vitamin or mineral deficiency of the diet The results rather are in strong support of a not at all modern point of view, namely, that the cause of dental decay is the decomposition, most likely by aciduric and acidogenic bacteria, of certain foodstuffs held by the teeth in some way or other

Those who in recent years have emphasized the importance of the diet from the standpoint of vitamins and minerals as a means of preventing caries or of checking the progress of caries in human teeth have overlooked or perhaps have ignored the fact that in changing from a deficient to an adequate diet there have no doubt been marked changes effected besides the increase in vitamin and mineral content of the diet The inclusion in the diet of greater quantities of fruits, vegetables and dairy products necessarily reduces the consumption of those foods which, because of their consistency and chemical make-up, have a tendency to be retained by the teeth and upon subsequent decomposition probably cause decay of the teeth That the quantity of these particular foodstuffs consumed is an important factor is indicated by the fact that in a series of experiments in which various mixtures of cornmeal and oatmeal were used in compounding the stock ration a gradual increase in the frequency and severity of caries was observed as the amount of cornmeal was increased Similar observations have been made in the case of other experimental diets in which different amounts of cornmeal were used The increase in the diet of the so-called "protective" foods is no doubt also accompanied by a change in the physical properties of the food mixture as it exists in the mouth, resulting possibly in a marked decrease in the tendency of food to be retained by the teeth There is also the possibility that the consumption of certain fruits, fruit juices or vegetables is accompanied by a definite cleansing of the teeth comparable perhaps to the conscientious use of a tooth brush in conjunction with an effective tooth paste

In view of the results of the experiments described above, it would appear desirable to give some attention in human dental studies to the physical properties of individual foods and of food mixtures with respect to their tendency for retention by the teeth. The elimination from the diet of foods that are difficult to remove from the teeth would perhaps go far in wiping out dental caries. It is also apparent from the results that a diet considered adequate merely from the chemical point of view is not necessarily a guarantee against dental decay

C A Hoppert
P A. Webber
T L Canniff

Department of Chemistry,
Michigan State College

THE EFFECT OF EPINEPHRIN-FREE SUPRARENAL EXTRACT ON THE SPECIFIC DYNAMIC ACTION OF FOODSTUFFS

In previous publications we[1] described a new calorogenic principle obtained from the suprarenal cortex or whole gland The active substance is combined in the lipoid fraction and can be extracted from the tissue with methyl or ethyl alcohol After concentration of the alcoholic extract *in vacuo* at a low temperature, the active protein-free lipoid is obtained by extraction with benzene or ether The water soluble extract of the lipoid contains epinephrin besides the active substance[2] Epinephrin, however, is less firmly bound by the lipoid and can first be removed by prolonged washing or mild acid hydrolysis The calorogenic principle, as we have pointed out, is unstable, but in the absence of oxygen we have found a preparation active after a period of 6 months In our earlier work the extract was administered orally but the effects were not always constant. Given hypodermically, approximately one tenth to one fifteenth the amount is required, and the results have been much more consistent.

In our clinical work we have noted that in many cases of asthenia, including myasthenia gravis and Addison's disease, the beneficial results obtained diminished upon continued administration of the extract Daily administration of amounts to dogs sufficient to raise the basal metabolism 40 to 50 per cent. would fail to maintain the increased metabolism after a few days This "fading" effect upon prolonged administration of the extract has been observed in connection with the increased mechanical efficiency and disappearance of the abnormal creatine excretion in certain asthenias that we have described. In 3 depancreatised dogs and in 3 diabetic patients we have noted that the extract decreases the sugar elimination (40 to 50 gms daily). One severe diabetic patient studied failed to show any such change. After 3 to 4 days the sugar elimination again returned to its former level even upon giving the extract.

In connection with the "fading" action we have noted a diminution or disappearance of the specific dynamic action of foodstuffs The following results were obtained after various periods of medication A normal control run was first obtained before treatment was started

Subjects studied

	Cases
0 5 gm protein gelatine (or egg white) per kilo orally	
S D A completely eliminated	6
S D A materially depressed	3
S D A no change	1
0 3 gm alanine per kilo intravenously	
S D A eliminated	1
S D A materially depressed	2
0 5 gm glucose per kilo intravenously	
S D A eliminated	4
S D A materially depressed	4

Normal dogs

	Cases
20 gms meat per kilo	
S D A completely eliminated	4
2 5 gms alanine per kilo orally	
S D A completely or nearly eliminated	2
2 5 glucose orally	
S D A completely eliminated	10
S D A markedly depressed	9

The rapidity of disappearance of the specific dynamic effect appears to be dependent upon the dosage and upon the duration of the period of medication

Alfred E. Koehler

Potter Metabolic Clinic,
Santa Barbara Cottage Hospital

---

[1] A E Koehler, *Proc* Soc Exp Biol and Med, 26: 296, 1928, A E Koehler and L. Eichelberger, *Amer. Jour Physiol*, 90 2, 1929

[2] A. E Koehler and L Eichelberger, *Jour. Biol Chem.*, 87: XXXVIII, 1930.

BOOKS RECEIVED

Carothers, Glen D *Values and Evaluations.* Pp. 99. Pfeifer Press.

Conger, George P. *A World of Epitomizations* Pp. xiv + 605 Princeton University Press. $5.00.

Gray, James *A Text-Book of Experimental Cytology.* Pp x + 516 205 figures. Cambridge University Press Macmillan $7 50

Holmyard, Eric J. *Makers of Chemistry.* Pp. xv + 314 98 figures. Oxford University Press. $2.50

National Research Council. *Bulletin No. 80.* Physics of the Earth—VI. The Age of the Earth. Pp. iv + 487. National Academy of Sciences. $4.50.

Piney, A , editor. *Recent Advances in Microscopy.* Pp. vii + 260. 83 figures. Blakiston. $3.50.

White, Errol I. *The Vertebrate Faunas of the English Eocene.* Volume I. Pp. xiv + 123 British Museum.

Wishart, G M. *Groundwork of Biophysics.* Pp. vii + 344. 81 figures. Bell. 12/6.

SCIENCE

Vol 74 FRIDAY, JULY 24, 1931 No 1908

The Metals in Electrochemistry PROFESSOR LOUIS KAHLENBERG .. 79

Some Remarks on Mathematical Statistics PROFESSOR H L RIETZ 82

Obituary
Dr Stephen Moulton Babcock PROFESSOR H L RUSSELL PRESIDENT GLENN FRANK *Recent Deaths* 86

Scientific Events
The Royal Botanic Society, Expenditures of the U S Public Health Service, Research Foundation of the University of Wisconsin, The Lamme Medal, Summer Work of the Botanists of Harvard University 88

Scientific Notes and News 91

Discussion
The Basic Sciences at the Chicago Centennial Exposition, 1933 COLONEL JOHN S SEWELL, *The Work of Chinese Botanists on the Flora of China* DR E D MERRILL *Exponents and Footnotes* DR F B SUMNER *Color* PROFESSOR W A NOYES 94

Special Correspondence
Grants in aid of the National Research Council DR VERNON KELLOGG 96

Societies and Meetings
The Texas Academy of Science H B PARKS *The New Hampshire Academy of Science* PROFESSOR GEO W WHITE 97

Scientific Apparatus and Laboratory Methods
A Simple Grinder for Soft Tissues DR CARL TENBROECK *A Simple Apparatus for Washing Protozoa* DR JOHN P TURNER 98

Special Articles
X Radiation and Regeneration in Amblystoma PROFESSOR ELMER G BUTLER *Effects on the Gonads of Cortico adrenal Extract* DR E L COREY and DR S W BRITTON *Antiurease* DR. JAMES B SUMNER and J STANLEY KIRK 100

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y

Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE METALS IN ELECTROCHEMISTRY[1]

By Professor LOUIS KAHLENBERG

UNIVERSITY OF WISCONSIN

ABOUT two thirds of the chemical elements recognized at present are metals Of these seven, namely, copper, gold, iron, lead, mercury, silver and tin, have been known since prehistoric times Antimony and bismuth were discovered by Basil Valentine in 1450, zinc by Paracelsus in 1520, and arsenic by Schroeder in 1694 In the latter half of the eighteenth century ten metals were discovered, namely, chromium 1797, cobalt 1773, manganese 1774, molybdenum 1782, nickel 1751, platinum 1741, tellurium 1782, titanium 1789, tungsten 1781 and uranium 1789 During the nineteenth century about forty-two new metals were discovered. Of these forty-two metals, about twenty-six were reported before 1850, and the remaining sixteen were recognized during the latter half of the century—fourteen of them being isolated before 1890 Radium and lutecium were discovered in the twentieth century

Thus most of our metals were discovered in the nineteenth century, particularly during the first half of that period, and during the three decades from 1860 to 1890 The reason for this lies mainly in the fact that electrolysis came into use with the electrolytic decomposition of water effected by Nicholson and Carlisle in 1800, and the introduction of practical spectroscopy by Bunsen and Kirchhoff in 1860 Electrolysis and spectroscopy, then, have greatly increased the number of metals (and also other elements) that we now know. Indeed, the finding of another new metal was so common during the nineteenth century that such discoveries almost became monotonous To be sure new elements have also been found by purely chemical means, that is to say, without electrolysis or spectroscopy Moreover, the periodic system of the elements as promulgated by Dimitri Mendelejew and Lothar Meyer suggested the existence of new hitherto unknown metals which were very soon found Furthermore, the discovery of radium in the present century has resulted in finding other elements that are radioactive In fact the pursuit of radioactivity has rivaled in intensity the efforts directed toward spectroscopy which date back to the latter half of the preceding century

---

[1] Presidential address at the meeting of the Electrochemical Society, Birmingham, Alabama, April 24, 1931

Now, while the metals are numerous, it is nevertheless true that the atmosphere and the great bulk of the oceans and the lithosphere as we know them are non-metallic, consisting largely of oxygen, hydrogen, nitrogen and silicon, though to be sure the latter has certain metallic qualities. It has been estimated by F W. Clarke that aluminum, the most abundant metal in the lithosphere, is present to the extent of 7.90 per cent , and iron which is next in order to the extent of 4 43 per cent , calcium, magnesium, sodium and potassium forming 3 44, 2 40, 2 43 and 2 45 per cent of the earth's crust respectively All other metals and non-metals constitute only a few tenths, and in most cases only a few hundredths, of a per cent. of the earth's crust.

Thus far the metals have played a special rôle in the development of electrochemistry, for they all conduct electricity and they are liberated from their compounds by electrolysis The latter fact caused Sir Humphry Davy to formulate the first electrochemical theory, which was to the effect that chemical affinity is in reality electrical attraction Much was made of this view, and the dualistic theory of Berzelius held sway for half a century In fact, dualism has by no means disappeared from our science The Arrhenius theory carries with it the essentials of dualism, and, indeed, the present much-heralded hypothesis that all matter is made up of protons and electrons is also dualistic in character. The notion that electricity is material came from the intensive study of Sir Joseph J. Thomson on the discharge of electricity through gases.

Though the idea of the atom dates back to ancient Greece, our present atomic theory, which has held sway for a century and a half, is founded upon the laws of stoichiometry, and our molecular theory has grown out of the law of Gay-Lussac of the combination of gases by volume So useful have the atomic and molecular conceptions been, and so intensively have they been preached and advocated, that it is almost dangerous to remind people that atoms and molecules are after all only theoretical entities How many persons actually know that we write the formula of water H_2O instead of HO simply because we want to hold Avogadro's hypothesis? How many actually know that the molecule of hydrogen is written H_2 simply because we want to hold Avogadro's hypothesis? Yet such hypothetical things, valuable though they be, are continually being regarded as actual facts, an attitude which can only retard true progress.

In the nineteenth century the physicists tacitly and even gladly accepted the chemical atoms and molecules founded upon the laws of combination by weight, and by volume in the case of gases. The physicists used the atomic and molecular conceptions in connection with their studies of electricity, heat, light and radiant phenomena with the result that now in the twentieth century they have concluded that the chemical atom is complex and made up of protons and electrons, *i.e.*, electrical particles or corpuscles much smaller than the atoms, whose so-called structure must consequently be studied The idea that electricity is material in character and that it is the primordial matter out of which our so-called chemical elements are composed has naturally opened up the old question of the transmutation of the elements and particularly the transmutation of the metals Indeed, observed transmutations have been reported as going on during the process of the decay of radioactive bodies, and thus the old dream of the alchemists has been renewed. While such observations have been reported as going on spontaneously, transmutations effected in the laboratory are lacking We still get our lead from the Ozarks.

In the study of the metals much has rightfully been made of the fact that the atmosphere surrounding a red-hot metal conducts electricity The explanation that this is due to electrical particles flying off from the hot metal recalls the old idea of phlogiston, a subtle material which was supposed to leave the metal when it was heated or burned The phlogistic theory was overthrown by the results obtained by exact experiments with the balance. Nevertheless, this revolution was not accomplished without a hard fight, and it should now be recalled that experimenters of the first order like Cavendish, Scheele and Priestley never relinquished the idea of phlogiston Now, indeed, what is essentially this same notion is again coming into the foreground under the name of the electronic theory, albeit it is now founded upon an array of experimental data, whereas a hundred and fifty years ago it was largely speculative in character, being based merely upon qualitative observations which were readily discounted in favor of the views of Lavoisier and his followers, who presented exact quantitative data, representing careful weighings, to substantiate their view of combustion.

The balance has had its innings for nearly a century and a half. While the work with the balance was fundamental and important and also inaugurated quantitative experimentation instead of qualitative or quasi-quantitative observations, nevertheless we are now coming to recognize that by no means everything is amenable to study with a balance. In other words, we are gradually emancipating ourselves from the tyranny of the balance. The old romantic spirit of phlogistic times is coming back. It was, indeed, kept alive by the discovery of Dulong and Petit that the heat capacity of the atoms is essentially the same, by Dr. Seebeck's famous discovery of thermo-couples, by Faraday's discovery that chemically equivalent quantities are deposited by the same current, by the thermochemical work of Julius Thomsen and Marcelin Berthelot, by the discovery of Wiedemann and Franz that heat conductance and electrical conductance go hand in hand, by the brilliant work of Bunsen and Kirchhoff on the spectra of the elements, by Crookes' experiments in vacuum tubes, by the x-ray work of Roentgen, and by the radioactive studies of Madam Curie. The fundamental researches of Volta on the contact potentials of the metals and his discovery of how to pile up E M F by connecting batteries in series are specially memorable. They inspired the later work of Kelvin, who measured the potentials of the various metals against his standard gold plate.

For a number of years it has been my privilege to report to this society the results of my researches on the electrochemical series of the metals, the potentials developed by the latter in various electrolytes and the replacing power which the metals exhibit toward one another. Recently the potentials developed by metals laden with gases came into consideration in these researches. All these experiments, and especially the last work on gas electrodes, have convinced me that the effects observed are due principally to the metals and their specific nature, and secondarily due to the electrolytes and gases with which the metals are in contact. This conclusion is in line with the idea expressed by Volta, by Kelvin, and, indeed, even by Nernst when in his theory of contact potential he endows the metals with a specific so-called solution tension.

Theoretically, it should be possible to deposit electrolytically any and all of the chemical elements, there is no limit as to the possibility of forming chemical compounds, both inorganic and organic, by means of the electric current or electric contrivances. In practice, we have developed rather slowly in these matters in recent years. We have been hampered because it has been difficult to find the suitable electrolyte, suitable electrodes, and also the proper conditions of temperature, potentials impressed and current densities to accomplish the purpose in hand. To be sure, in many ways enormous strides have been made in our electrochemical industries. It is not the purpose to rehearse these here. We are plating with chromium now. How to plate with tungsten will be told us at this meeting and perhaps ere long we shall learn how to plate with silicon or even with boron. Yet these are minor details as compared with the great problem of gaining a better understanding of the fundamental nature of the metallic state itself. What is it that gives metals their peculiar and highly specialized character? Why do they conduct electricity? Why are they ductile and malleable and strong in some cases and not in others? Why are they all opaque? Why are they silvery white to steel gray in hue with the sole exceptions of the two colored metals—gold and copper? Why are some of the metals so intensely poisonous to plants and animals and others not? Why are some of the metals so absolutely necessary in considerable quantities in life processes and others not? These and many other questions suggest themselves and must eventually be answered.

The great problem to-day is not to find more new metals, but rather to reduce the present number by showing that they are complex, that they can actually be resolved into something simpler, and that they can be synthesized in actual practice. In this work our present atomic theory, founded as it is upon the weight relations that obtain in chemical combinations, will probably avail us little or nothing. In fact the intensive efforts at unravelling the so-called atomic structure of the elements by means of miniature astronomical models, while interesting, are entirely too significant and do not suggest how to proceed experimentally to accomplish the proposed task. New and novel experimental methods of inquiry must be found. This is the order of the day. Are we of the twentieth century to sit by and try to solve our problems at the writing desk by means of models and equations which start from fixed assumptions and preconceived notions that have ever been recognized as the chief bar to scientific progress? Or are we to go into the laboratory and workshop unhampered mentally and once more guided by the inspiration of the spirit of the great experimental geniuses of the past, using the far superior experimental means at our command, seek to find entirely new and novel ways of approaching the problem of the riddle of the metals? Once this is solved, it will doubtless carry with it the solution of many other fundamental questions. One who continually works with the metals in the chemical and physical laboratories can hardly divest himself of the idea that there is something fundamental which the metals have in common that has thus far entirely escaped us.

The most promising line of experimentation before us at the present time seems to lie in the study of the phenomena in high vacua, in the photoelectric investigations, in the systematic inquiry into thermoelectric and radioelectric effects, and in alternating current rectifiers Naturally great experimental difficulties are encountered in inquiries of this kind and these are augmented by the inordinate desire to gain premature theoretical conceptions, especially mechanical conceptions of what takes place, when the phenomena in question are probably not at all amenable to explanations of this nature We must learn to work by faith and inspiration We must learn again to divine the truth We must be led as such geniuses as Davy and Faraday were led in their experimental inquiries What guided them in their fundamental discoveries was a species of intuition, and not complex mechanical theoretical conceptions made still more obstruse by intricate, yet nevertheless quite inadequate, mathematical equations and expressions Theories have their place They are useful but they must not be taken too seriously They must not be believed too hard lest they enslave us and bind us to earth It is highly desirable to keep the minds and spirits of our younger generation free and unhampered by too serious consideration of theoretical conceptions with which present-day scientific literature overabounds Rather a jovial, happy-go-lucky spirit of experimentation is to be cultivated, for as the great poet Goethe has put it—"Grau teurer Freund ist alle Theorie und grun des Lebens goldener Baum"

In this spirit and in this sense our efforts toward opening new avenues of inquiry by stimulating novel ways of experimentation that are calculated to reveal undreamt of vistas, our society has established its new division of electronics and paralleled the same with electrothermics and electro-deposition May this new field prove specially fruitful, may it provoke thought and discussion and yield experimental results of a basal character that shall call for additional, novel divisions of our society so that the ends for which it was founded may truly be realized

SOME REMARKS ON MATHEMATICAL STATISTICS[1]

By Professor H L. RIETZ
UNIVERSITY OF IOWA

IN casting about for a favorite topic on which to address you on this occasion, I was anxious to give much weight to your feelings as to what would be most appropriate considering both your interests and my limitations It seemed fairly obvious that you would wish me to speak on a subject of which I have some special knowledge and to which I have made at least a few contributions These conditions determined the general field in which to select a topic In spite of these great limitations I wrote down a dozen or more specific topics, but finally selected a subject so broad that it leaves plenty of room for suitable limitations as we proceed In this way it has come about that I am to make some remarks on mathematical statistics Although much that I shall say may be an old story to many of you, I shall find something of a child's delight in "saying it again" if I can say it in such a manner as to interest you

The statistician engaged in the collection of data has sometimes been pictured, like Sam Johnson's maker of dictionaries, as the slave of science doomed only to gather together the material with which others build and press forward to conquest and glory While this picture may portray a modicum of truth, my experience of over twenty years in the examination of data obtained from a great variety of sources leads me to think that the genuine collector of material ordinarily enjoys the process of collecting more than he would enjoy the more difficult thinking involved in the analysis and interpretation of the data The analysis of available data often lags far behind the process of collection, particularly in cases of organized research It is in the process of analysis that mathematical statistics has become, to a very considerable extent, the servant of science

The publication of the "Théorie Analytique des Probabilités" of Laplace in 1812 marked the culmination of the first great period of activity in the development of the principles underlying mathematical statistics In fact, the publication of this monumental work of Laplace practically closed the first great epoch of the development of these principles, for, following this publication, relatively few outstanding results or central theorems of mathematical statistics were contributed until our current period of activity which started in the decade 1890 to 1900, with the development of generalized frequency curves and a theory of correlation To be sure the DeMoivre-Laplace law of error was developed by Gauss and given its important place in the adjustment of observations, but there was, on the whole, relatively little progress.

The activity of the decade 1890 to 1900 may be properly regarded as the inauguration of the second great epoch in the development of mathematical statistics. As early as 1895 the fact had become fairly well established from the analysis of frequency distributions of very excellent anthropological and biological data that the Gaussian or normal probability curve is inadequate to represent many important frequency distributions When the problem of developing generalized frequency curves was finally attacked, the attack was made from several different directions Thiele and Charlier in Scandinavian countries, Pearson and Edgeworth in England, Fechner and Bruns in Germany developed theories of generalized frequency curves from very different view-points

---

[1] Presidential address before the Iowa Academy of Science, May 1, 1931

As a result of these different view-points, there have been developed several different systems of frequency curves While any expression of preference for a pet system of frequency curves is likely to lead to controversy, I shall have the temerity to say that the Pearson system holds first place and that it and the Gram-Charlier system have been used to such an extent that they may, from certain points of view, be fairly regarded as the major systems, whereas the translation system of Edgeworth, the transformation system of Kapteyn, the logarithmic normal curve and others may be regarded as minor systems

Pearson provided at first four types of curves, then increased the number to seven and finally in 1916 to twelve We have two types in the Gram-Charlier system However, the latter system involves infinite series and might on this account be regarded as consisting of many types We not infrequently hear the question, What is the primary object of generalized frequency curves which seem rather complicated to many scientists and non-mathematical statisticians? My answer is first that the development of generalized frequency curves from plausible underlying laws of probability represents the results of the desire of the human mind to produce a sort of theoretical norms to serve as models for describing and analyzing both observed frequency distributions, and the expected distributions of results from repeated observations Next, the type of frequency curve that will fit an observed distribution is likely to suggest appropriate assumptions for a mathematical treatment Finally, it seems that to seek the laws of distribution of statistics is the outgrowth of a natural movement to which a distinguished botanist, the late Professor J Arthur Harris, aptly directed attention in the following words of an address given a short time before his death. "Apparently all the physical and biological sciences move in their development toward a final period, not yet surpassed in any of the sciences, of mathematical description and analysis, and of the formulation of mathematical laws"

We turn next to a brief mention of the development of the theory of correlation. In mathematics, the bulk of our work and energy in the study of relations has been put into the consideration of very precise relations known as functional relations. Thus, we have given much consideration to situations in which x and y are so related that when x is given, y can be calculated or is at least determined A fair amount of energy has also been put into the consideration of the association of elements under the assumption that they are independent in the probability sense of independence. We thus consider, in the main, what may be called cases of perfect dependence at one extreme and of perfect independence at the other. Such mathematical concepts have served very well the needs of a wide range of physical applications. But a new kind of mathematical concept was needed to deal with the region between the two extremes In this intermediate region there lies apparently a large field of investigation that I may perhaps appropriately call the field of correlation theory. In the usual field of mathematical relations, the primary question is given an assigned x what corresponding value of y is determined? In this new field the corresponding question is given an assigned x, what is the probability that the corresponding y will take a prescribed value, or what are the probabilities that y will take any one or more of a certain prescribed set of values?

Correlation theory was early extended to deal with n variables in correspondence where n is any positive integer The geometry of this situation has led into space of n + 1 dimensions, and has served to illustrate Karl Pearson's remark that a knowledge of space of four or more dimensions is essential to an exact study of the diseases of defective children

Many of the formulas of correlation theory are identical with the formulas of hyperspherical geometry. In this connection let me recall to you the address of Professor Dunham Jackson before this Academy three years ago in which he gave an elegant exposition of correlation by appealing to the geometry of n dimensions

While I think I am appreciative of the usefulness and importance of the method of correlation, it is only frank to say that mathematicians are rather generally inclined to regard the method as having an empirical flavor. Although certain norms in the nature of mathematical functions suggested by laws of probability are involved in the theory, there is involved also a good deal in the line of curve fitting which has some resemblance to the fitting of empirical curves to data. The main purpose of one of my papers published about ten years ago under the title "Urn Schemata as a Basis for the Development of Correlation Theory" was to remove from correlation theory something of its empirical character. The suggestion of this development came from the fact that the most fundamental theorems in the mathematics of statistics, say the Bernoulli theorem and the DeMoivre-Laplace theorem, are derived from urn schemata involving pure chance. In this connection it should be said that the late Professor Tschuprow, a Russian mathematician, took an important step in advance in his book on correlation published in 1925, towards connecting correlation analysis more closely with the abstract theory of probability.

We turn next to a brief consideration of recent progress in the solution of problems of random sampling. Most of our statistical investigations are in the nature of inquiries by taking a sample from a large and possibly infinite supply of material. To give a very simple illustration, we make a statistical inquiry about a characteristic of a whole class of men by taking a random sample of, say, 100, 1,000 or 10,000. Of course, this is not absolutely unlike the experimental procedure in the most exact sciences. Thus, the physicist and the chemist take small samples of a large supply of material. The difference lies in the degree of variability of the material. The individual items of the random samples taken by the statistician are often decidedly variable compared with the samples ordinarily taken by the physicist or the chemist. However, there seems to be no sharp line of distinction between statistical and non-statistical data. The data of the biologist are in many cases decidedly variable which is tantamount to saying the statistical elements are prominent.

A few years ago R. A. Fisher proposed the word "statistic"—the singular of the word "statistics"—for any result such as an average or an index calculated from a sample. We shall adopt this suggestion in the present paper, although the plural "statistics" in this sense is objectionable. A statistic varies from sample to sample. One of the main concerns of mathematical statistics is with the problems of variation and distribution of a given statistic. In attempting to draw inferences about the class of material from which a sample has been drawn by means of such a statistic as an arithmetic mean, a standard deviation, a correlation coefficient, or a regression coefficient, the essential inquiry is about the sampling fluctuations of the statistic, at least to the extent of knowing its probable error or some other appropriate measure of sampling fluctuations. Probable errors were first worked out for a few important statistics on the assumption that the distribution of a statistic would follow the normal probability curve. The problems were difficult even under this simple assumption. Student published in 1908 on the distribution of the ratio of the discrepancy of the mean of a sample from the mean of the population to the standard deviation of the sample drawn from a normal distribution. The distribution of this important ratio, which I call the Student ratio, has made it clear to statisticians that, with small samples, it is invalid to assume that almost any useful statistic is normally distributed. To carry the new knowledge about the distribution of the Student ratio into practical statistics, we now have a new probability table that should ordinarily be used by the practical statistician in place of the normal probability table in testing the significance of means obtained from rather small samples.

At the beginning of the present century, the exact knowledge of the distribution laws of statistics seems to have consisted in that of the arithmetic mean of items drawn from a normal distribution together with that of the mean-square for items from a normal distribution. Further than this, the distribution of the arithmetic mean for items from a uniform distribution was probably known. To this meager knowledge considerable has been contributed since the year 1900. In 1915 R. A. Fisher succeeded in giving the theoretical distribution of correlation coefficients obtained from samples of n-pairs drawn from normal distributions for any value n.

With the beginning made by Student in 1908, we have been for the past fifteen years in the period of unusual activity in attempts to find properties of the distribution laws of various important statistics. As a result of this activity we know a good deal about the nature of the distribution of the most important statistics for random samples drawn from a normal parent distribution. We know a little about distributions of a few statistics calculated from samples drawn from some very simple non-normal distributions, but, on the whole, we may say that large problems still await exact solution in cases in which the parent distribution is not normal.

In the foregoing remarks I have tried to give the main lines of a picture of some of the recent activities in mathematical statistics. As closing comments I wish to turn in another direction and submit for your consideration a few remarks on the place of statistical methods and views in science. In this connection I shall draw freely on certain views admirably expressed by Josiah Royce growing out of Maxwell's classification of the methods of science.

Maxwell recognized three main methods in science: The historical method, the mechanistic method and the statistical method. By the historical method science deals largely with individual events. An example of this method would be the scientific treatment of a comet by observations, or the classification and meaning of a geological specimen. By the mechanistic method, science deals mainly with invariant laws to which all events of a certain class conform, and when such laws exist, they can be used to compute and predict future events. This method is concerned with the individual event in so far as it was predicted by the law Thus, the mechanistic method is concerned with the exact prediction of the individual comet but this concern is very different from that involved in the historical view of the comet The triumphs of mathematical astronomy, and of analytical mechanics, furnish some of our most striking examples of the success and satisfaction that go with the mechanistic view No one has any doubt about the importance of the achievements resulting from this view

In taking the statistical view, the main motive does not center about the individual event nor about the invariant law Its concern centers about the average and probable constitution of a set of variable items and about the probability that this average will remain stable within certain limits of approximation The world of the statistical view consists of individual items, but the main interest lies no longer in each individual item. The statistical view is concerned mainly with a set of items It may turn out that the occurrences conform to a law, but the law sought by the statistical method is an account of the collection of events in terms of averages and probabilities

Royce illustrated the way the statistical view contrasts with both the historical and mechanistic views by considering how each point of view applies to an event such as is expressed in the assertion "A killed B" For a strictly historical point of view this event is a unique occurrence—possibly a free-will act It falls under moral and criminal laws For a strictly mechanistic view of things, the killing resembles the appearance of a comet which could have been predicted Unique as it is, it is supposed to have been essentially predictable. The argument would perhaps run somewhat as follows If you had known the precise configurations of all the physical particles in the world at some appropriate moment and the laws governing these particles then this killing could have been calculated in advance. It is a mere case of law—a point of some life line.

But from the statistical point of view the killing of B by A is an event against which insurance provision could have been made in advance—not because it could have been predicted that A would kill B, but rather because this individual occurrence could not have been predicted and because the death rate of men of B's age can be statistically calculated with approximate and probable accuracy, so as to make a policy insuring B's life a contract whose value is calculable, not on mechanistic but on statistical grounds. You might be interested in contrasting the views of life insurance under the statistical view with that under the mechanistic view. Under the mechanistic view, we should hold that except for our present ignorance of the physics, chemistry and mechanics of life, we could calculate and perhaps announce the date of each man's funeral at the time of his birth or earlier All our life annuities would become annuities certain This seems fanciful and somewhat ridiculous, but it would seem to be the logical consequence of making the mechanistic view the only view in science

It seems to be a fact that the actual scientific knowledge of phenomena touching life most directly is, in the main, statistical knowledge It is the sort of knowledge exemplified by mortality tables This applies to what we know about heredity, birth, growth, behavior and death It applies to economic processes and social transformations Even if life be a mechanism, its phenomena are best known in terms of statistical averages and probabilities Again the deeper knowledge of our most exact sciences seems to be pointing more and more to the conclusion that many fundamental problems of physics are statistical in nature Thus, problems of atomic structure are regarded as statistical with the results stated in terms of probabilities. The individual electron does not seem to follow strictly determinate laws We are told that either its location or its velocity remains in doubt Its future motion can not be exactly determined, nor can its past motion be exactly given This does not seem to be due to imperfect devices of observation and measurement, but to an inherent characteristic of matter The principle of uncertainty in relation to either the position or the velocity of an electron is a statistical statement It is fairly obvious that the influence of this principle of uncertainty is being felt in the philosophy of science Perhaps some of you will recall in this connection a paper by Professor Warren Weaver in *The Scientific Monthly* for November, 1930, on "The Reign of Probability" His concluding sentence is that "the first part of the twentieth century (and we know not how much more) should be known as the reign of probability"

In considering the place of the statistical views in science, the question naturally arises Is the statistical method in science simply a substitute for the mechanistic method or a last resort when the situation becomes so complicated that we give up making predictions about each individual item by any calculable process? It may seem so from a first impression of what has been said in this paper. Moreover, I think the statistical method is frequently in the nature of a last resort with regrets that we can not adopt the mechanistic view. However, I do not believe this description covers the ground reasonably if we should review the rationale of the whole situation. The statistical method has a rationale of its own In this connection, it may be well to recall that the validity of a proposition about physical phenomena under the mechanistic view at its best depends in the last analysis on verifications that usually involve errors of observations and approximate numerical computations On account of such errors, we are unable to assert that the very exact proposition of the mechanistic view is literally true On the other hand, we may be able to verify and assert in certain cases that the proposition in the statistical view is literally true, although it is a proposition about the probable and approximate It thus seems to be a tenable position that the statistical view should not be regarded in all cases as a last resort

In conclusion, the plausible inference is that along with our reverence for the mechanistic view and its achievements, it seems appropriate to recognize its limitations, and to develop also an appreciation for the rationale as well as for the convenience of the statistical view However, it is not my intention to exaggerate the importance of the statistical view In practice, it is usually the joining of statistical and mechanistic considerations that makes it possible to get workable results out of what appear on the surface to be weak and often meaningless relative frequencies and averages The extensive analysis of data by improved statistical methods is a great step in advance, but such analysis will remain relatively sterile unless it is supplemented by the formulation of useful or interesting theories

OBITUARY

STEPHEN MOULTON BABCOCK

WISCONSIN'S Grand Old Man is dead! The news has been flashed around the world that Stephen Moulton Babcock has closed his earthly labors Working away daily with that patient, purposeful persistence that has characterized his assiduous labors for decades in his efforts to wrest from nature the mystery of the interrelations of energy and matter, to-night the busy mind is stilled The laboratory that has afforded him the material vehicle through which his imagination played is silent The pendulum that is so delicately adjusted that the doctor hoped he would be able to measure its variation in temperature as the weight swings to and fro will continue to vibrate until the mechanism runs down, but the hand of the master will no longer record its beat The book was closed as he would have had it The chapter was not finished, but a few days ago he added here and there a line, working away with undimmed enthusiasm that has been the marvel of his friends these many years Rich in years that have been filled to the brim with new ideas that have kept his mind young and elastic, he has labored on and on The joy of life to him was always the unsated quest

Science is an exacting goddess She brooks no rivals He who would woo her and win must forego many of the allurements that detract the mind that generates new ideas But to Babcock nothing could swerve him from his steadfact devotion to her cause.

The University of Wisconsin has had its share of really great men Some have been great in the teaching field, some for their power of lucid statement through the spoken word that burned its way into the minds and hearts of men Babcock was the scientist—the explorer who loved to push back the boundaries of the unknown. He knew no fatigue if any unsolved problem arose in his pathway. The joy of conquest appealed to him as it does to the finder of some undiscovered bourne, yet he would have hated to have been forced to organize his discoveries and reduce them to formal treatment One thing he often said he never would do and that was to write a book

The Spartan spirit of the pioneer marked his own method of research He would not tolerate an assistant Time after time Dean Henry, in the early days of the experiment station, would try to help him multiply his fingers through additional help, but it was of no avail He would rather whittle out a piece of apparatus with his jack-knife (and the writer has seen many a piece so constructed) than to have a finely calibrated mechanically perfect device made for him in the machine shops He used to say he could think better if he was using his own hands in fashioning the tools he needed

Babcock lived in the right age to bring out the best that was in him His pioneer spirit would fain spend but little time in poring over the writings of others to classify knowledge that already existed He had but little regard for self-constituted authority If a statement occurred in a book this was almost *prima facie* evidence that it had been borrowed from some other source, far too frequently, books masquerade in borrowed plumage. The laboratory, not the library, was where Babcock sought truth He knew that nature would not lie, but he was never quite sure that man might not have erred in making the record.

Fortunately for Babcock, he had no graduate school to tie him down to Procrustean limits. I doubt whether he would ever have submitted to the exactions of a seminar But those of us who have been fortunate enough to work where we caught now and then a glimpse of the movement of his scientific mind have indeed had a rare privilege It was as if an angel had touched our lips with a coal from off the altar.

Such contacts have meant everything to Wisconsin. For fifty years this spirit has moved among us. The Wisconsin Experiment Station has done a great work, and when all is said and done, the spirit of Babcock has been the pervasive power that has been imminent through it all.

It was Babcock's refusal to adopt the then prevalent notion that a completely balanced ration could be constructed on the basis of chemical analysis that led later here at Wisconsin to the epoch-making discoveries in the field of vitamin research and the rôle of mineral elements in the nutrition of animal life. While Babcock was a chemist, he was no such blind adherent to chemical methods that he lost sight of the fact that life was made up of something which could not be put into a test-tube.

Twenty-five years ago, Hart and his colleagues started their famous single ration diet for cattle, the results of which have made it necessary to rewrite almost wholly the text-books on nutrition, both as to the human as well as the animal. The germ of this suggestion came from Babcock's untrammeled mind. It was here that the torch was passed from the hand of the master to the pupil.

The world at large knows Babcock primarily for the beneficent invention of his famous test for butter fat, whereby the intrinsic value of milk could be easily and accurately determined. This came at a most opportune time and is one of the foundation stones on which the modern science of dairying has been built. Prior to this time, dairying was merely a haphazard art, but with this tool in hand the tremendous advance in the improvement of the special dairy breeds of cattle became possible.

The wide-spread utilization of the Babcock test made such unscrupulous practices as adulteration, watering and skimming the milk no longer profitable, because the test enabled such deceit to be quickly detected. As Governor Hoard once said the Babcock test had made more dairymen honest than had the Bible because of the summary verdict which it rendered.

Babcock's phenomenal grasp of the essentials of any problem to which he directed his attention is well shown by the remarkable contribution which he made in the field of physiology. His studies on "metabolic water," *i.e.*, liquids produced in the bodies of insects living upon perfectly dry matter made a new chapter in the physiology of metabolism. He bred clothes moths and carpet beetles, living on air-dry woolens and found that these animals could produce enough water as a result of their own life processes to bathe their body cells so that their normal functional activity could be carried on. From the standpoint of actual contribution to the advancement of science, Babcock always considered this his most important biological discovery.

It is impossible now to assign a proper value to his researches on the constitution of matter on which he has been laboring for almost two decades. He has been urged to give these results to the scientific world but characteristically he would not do so, because he did not feel that they were wholly complete. For the past twenty years, he has been working in his own way, reducing his ideas so far as he could to an experimental basis. During the past two years he has been very sanguine that he was going to be able to demonstrate in an experimental way some of the principles on which he has spent these years of thought and study. The record has been reduced to written form, and in his will this unpublished manuscript is to be given to the university. It is to be hoped that this work may soon be made available for the study of others.

To the world at large the name of Babcock will long be held in reverence, along with the great men that have left their impress on the minds of men, but the genial and jolly Babcock will always be the memory of those of us who were fortunate enough to have the privilege of actual association with him.

H. L. RUSSELL

ADDRESS GIVEN AT THE FUNERAL SERVICES IN MEMORY OF STEPHEN MOULTON BABCOCK

EXPRESSING the mood of myriads of men and women throughout the world, who have known the boon of his spirit or the beneficence of his science, the University of Wisconsin to-day bares its head and bows its heart before the memory of Stephen Moulton Babcock.

Inventor of a device and a formula that emancipated the dairy farmer from the injustice of the rule of thumb that long prevailed in the market place!

Trail blazer in the crucially important field of vitamin research!

Symbol of the best that the pursuit of science generates in the scholar and gives to the state!

Joyous comrade!

A friend beloved beyond measure!

Inspirer incomparable of the vast army of young scholars serving as acolytes at the altar of science!

Like the great seminal minds of the Renaissance, this grand old doctor of science was himself greater than anything he did, and thus, in death, he gives to us, the legatees of his spirit, a goal towards which to point the education and the science of our time.

This merry man of many years was made of the stuff that gives mankind its saints and its martyrs. But he was a saint without seriousness, and he could have gone to martyrdom, without a murmur of self-pity, as part of the day's work

For his was a casual greatness!

He pursued the most painstaking research as if he were playing a game He brought to his tasks that gaiety of spirit which authentic greatness can afford His spirit never surrendered that incorrigible playfulness which so often marks men of power He brought laughter into the laboratory, for there was about him that deceptively careless air which creative spirits have as they go about their business

But there was toughness to the fiber of his mind!

He was a teacher who scorned the tyranny of the text-books, and he did not think it impertinent to doubt the authorities Each morning he met the universe with a question His was the creative heresy of an insatiable curiosity The cleansing winds of the critical spirit swept freely and forever through his mind

He belongs to the apostolic succession of the great pioneers of research—Pythagoras, Aristotle, Archimedes, Copernicus, Galileo, Harvey, Newton, Lavoisier, Dalton, Faraday, Helmholtz, Darwin, Pasteur, Gregor Mendel and Einstein, for, like them, he was an adventurer into the unknown to whom research was an intellectual passion rather than an institutional ritual, to whom creative thinking was more important than elaborate equipment, and for whom there was no barricaded frontier between pure and applied science

In an age when scholars all too often hasten to publish even before they prove their findings, he was content to let his greatest work speak for itself, for perhaps the most illuminating fact of his career is that he never published so much as a word about his part in the discovery, definition and defeat of that "hidden hunger" from which man and beast might die while eating their fill

In an age smitten with the passion for publicity, he forgot himself into immortality!

And in the midst of the sickness of an acquisitive society, his spirit remained unsullied even by legitimate personal considerations!

> Scholar of a great university!
> Servant of a great state!
> Shy benefactor of mankind everywhere!
> Laughing saint of science!
> Being dead he yet speaks!

Glenn Frank

University of Wisconsin

RECENT DEATHS

Dr Daniel A K Steele, dean of the College of Medicine and head of the department of surgery of the University of Illinois, from 1882 to 1917, died on July 19, aged seventy-nine years

Frederic Dunn Bell, until last year chairman of the board of directors of the Lederle Antitoxin Laboratories of New York, and secretary of the New York Tuberculosis and Health Association, died on July 17

Major T F Chipp, assistant director of the Botanical Gardens, Kew, died on June 28

Truman P Gaylord, vice-president of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, formerly assistant professor of electrical engineering at the Armour Institute of Technology, died suddenly on July 5 at the age of sixty years

Herbert Tomlinson, F R S, formerly principal of the South-Western Polytechnic at Chelsea, England, known for his work on the properties of matter, died on June 12 at the age of eighty-six years

Nature reports the death on April 16 of Miss Anne L. Massy, known for her work on the pteropods and cephalopods

SCIENTIFIC EVENTS

THE ROYAL BOTANIC SOCIETY

According to a report in the London *Times*, numerous fellows of the Royal Botanic Society attended a recent meeting at the Royal Botanical Gardens to hear a statement which foreshadowed the dissolution of the society at the end of the year in consequence of the decision of the Treasury not to renew the lease of the gardens While the break-up of the society in its present form seemed to be regarded as inevitable, hopes were expressed that the gardens might yet be preserved, and Colonel T. C Moore, M P, who has been in recent touch with Mr Lansbury on the question, was co-opted a member of the council The First Commissioner of Works, he said, had given him an undertaking that if any proposition could be made which would bring a more democratic influence to the gardens and yet make it possible to run them without loss it would be given favorable consideration

Mr. C C Hoyer Millar, who presided, said that the lease of the gardens would expire on April 5 next year He described the long struggle of the council to retain them, and expressed their deep regret that efforts to obtain a new lease had been of no avail Mr Lansbury, while reminding them that the Treasury had decided several years ago that as all the various leases in the park expired, they were not to be renewed, was sympathetic, but said he failed to see how the decision could be reversed, though personally he would be glad if some arrangement might be made for the society's work to be continued

There appeared to be no alternative but the dissolution of the society Other sites outside London had been suggested, but the revenue had largely decreased since the Treasury's decision was made public, many fellows had resigned, and the depressing economic position and heavy taxation had caused the cessation of several important and remunerative functions Expenditure had been curtailed as much as possible, but the fall in receipts made it impossible to cope with the position Arrangements were being made to dispose of the stock of plants in the conservatories and houses, the contents of the library and museum, and the furniture in the fellows' rooms and offices

In reply to a question about the present financial position of the society, the chairman said that they had £1,365 in the bank, and that expenses last year averaged £500 to £600 a month They could not tell exactly how long they could carry on, but there was little chance of it being longer than December 31

Colonel Moore outlined proposals for the retention of the society with fresh support from the public, a membership which would carry certain rights of admission to the gardens, a general charge of 3d for the admission of the public, and the institution of two free days a week He suggested that they should carry on to the end of the year and see that nothing was done to handicap the consideration of the proposed scheme Mr Greenwood, who for many years was the honorary treasurer of the society, regretted that Colonel Moore had not put his views before the council earlier, but said that if such a scheme as had been outlined could be carried out, all the fellows would be content

EXPENDITURES OF THE U S PUBLIC HEALTH SERVICE

THE U S Public Health Service has expended in the drought states thus far $389,000 of the $2,000,000 drought relief health fund appropriated by the last Congress, according to a statement July 16 by the service.

In all probability this fund already has served to prevent serious outbreaks of disease in certain areas The amount expended has been apportioned among 16 needy states, and allotments during the present fiscal year ending June 30, 1932, probably will be made to 20 states.

States in the dry area are doing their utmost to keep up their share of the expenses of maintaining health conditions in stricken districts, although many of them have been forced to obtain aid from the Federal Government Numerous local health units probably would have been forced to suspend operations from lack of funds, if this help from the National Government had not been forthcoming

The Public Health Service is using the utmost care in administering the $2,000,000 set aside for drought health relief States calling for money are required to budget each item that they claim they need, and must show why they are asking for federal funds Other Federal Government units have furnished information upon which the service partially has based its policies in administering the fund

A total of $1,551,000 available for the fiscal year 1932 has been alloted to the states This amount is what remains of the $2,000,000 fund less the money already expended, and less $60,000 for administrative expenses and a small reserve to meet extreme emergencies

The amounts already expended in the states (A), the amounts allotted for distribution before the end of this fiscal year (B), and the totals for each state out of the entire drought relief fund (C) are as follows

	A	B	C
Alabama	$ 15,295	$ 53,370	$ 68,665
Arkansas	74,155	155,916	230,071
Georgia	11,689	64,600	76,289
Illinois	16,719	48,405	65,124
Indiana	2,079	48,600	50,679
Kansas		26,892	26,892
Kentucky	32,025	266,801	298,826
Louisiana	26,660	66,810	93,470
Mississippi	21,338	124,639	145,977
Missouri	21,295	138,900	160,195
Montana	2,790	10,000	12,790
North Carolina		42,676	42,676
Oklahoma	20,201	75,680	95,881
Pennsylvania	25,343	16,379	41,722
Tennessee	56,278	89,247	145,525
Texas	22,733	130,266	152,999
Virginia	13,195	83,972	97,167
West Virginia	18,507	108,537	127,044
Total	$380,202	$1,551,690	$1,931,892

RESEARCH FOUNDATION OF THE UNIVERSITY OF WISCONSIN

THE Wisconsin Alumni Research Foundation has presented to the board of regents of the University of Wisconsin a report reviewing the results of its work during the first five years of its existence

The foundation, the first of its kind inaugurated at a university, was incorporated on a non-profit sharing basis on November 14, 1925, and had as its avowed purpose "to promote, encourage and aid scientific investigations and research at the university, and to assist in providing the means and machinery by which the scientific discoveries and inventions of the staff may be developed and patented, and their public and commercial uses determined."

It is pointed out that the methods pursued by the foundation have the advantage of securing patent protection and that the income from such patents is used for the support of research which is in general for the benefit of the public

Starting with nothing more than the willingness of Dr Harry Steenbock to turn over to the foundation an idea that was subject to patent in order to protect it from misuse, the organization already has earned an invested capital of $406,594, the income from which is now being used to protect its patents and for the public welfare through the furtherance of scientific research

On June 1 of this year the foundation made use of its right to control the price of two of the products based on the Steenbock process by bringing about a 25 per cent reduction in the price of these products to millions of consumers the world over

Besides making possible these products, the discoveries of Professor Steenbock on the development of vitamin D in activating pharmaceutical and food products have been shown to be of material value to health, especially in the fortification of food intimately connected with the nutrition of the young, the health-giving properties of the process are now to be applied to the dairy field.

Holding that it is better to offer the discoverer some financial recognition for the large amount of work he had done, memorandum agreements were worked out by which, after all expenses had been repaid, 15 per cent of the net proceeds from the patents go to the discoverer or inventor, while the remaining 85 per cent is received by the foundation

At the present time 11 patents or applications on discoveries made by university men are the property of the foundation. Most of these have been patented in nearly all the leading countries of the world

Following three general principles for guidance in the allocation of funds for research, the foundation began to give aid to research during the fiscal year 1928–1929 To stimulate interest in the graduate body of the university, a lectureship in science was established, and at the same time aid was given to certain definite lines of scientific endeavor

During the coming year, aid will be extended by the foundation to nine different projects in research The sum of $21,500 for grants-in-aid to these different research projects has already been allocated by the foundation trustees.

THE LAMME MEDAL

IN 1920, Dr. T. C Mendenhall, who was the first member elected to the original faculty of the Ohio State University, presented to the university a fund to provide for a medal to be called, in memory of a scientific friend of his early years, the Joseph Sullivant Medal This medal is given once in five years to a graduate or faculty member who has "completed a really notable work in either the liberal, the fine or the mechanical arts, the pure or applied sciences, including the various branches of engineering" Mr Benjamin G Lamme, chief engineer of the Westinghouse Electric and Manufacturing Company, a graduate in mechanical engineering of the class of 1888, was the first to receive this medal. The medal was presented at a special convocation at which Dr Elihu Thomson made the principal address Mr Lamme is said to have been highly gratified to have on the stage with him Dr Thomson and Dr Mendenhall, the two men whose character and attainments had served as his ideals since his early college years.

His appreciation of the Sullivant Medal and his interest in engineers and engineering education caused Mr. Lamme to provide in his will for several medals and scholarships One of the medals is given by the Society for the Promotion of Engineering Education for outstanding achievement in engineering teaching. A similar medal is given by the Ohio State University to a graduate of one of its technical departments for meritorious achievement in engineering

The first presentation of this medal has already been announced in SCIENCE It was made at the June convocation of the Ohio State University. Medals were given to Charles Edward Skinner, assistant director of engineering, Westinghouse Electric and Manufacturing Company, a graduate in mechanical engineering of the class of 1890, and to Arno Carl Fieldner, chief engineer, Experiment Stations Division, U S Bureau of Mines, a graduate in chemical engineering, class of 1906.

SUMMER WORK OF THE BOTANISTS OF HARVARD UNIVERSITY

PROFESSOR J G JACK expects to devote most of his time during the summer to the Arnold Arboretum, but a part of it may be required at the Harvard Biological Laboratory and Botanic Garden at Soledad, Cuba, where he spent the month of March. Alfred Rehder, curator of the Herbarium of the arboretum, who spent the summer of last year and of 1928 in various European herbaria, chiefly in the examination and photographing of types of plants of eastern Asia, will give most of his time this year to working out the results of these studies. Professor J. H. Faull will devote his research efforts in various parts of eastern America to the diseases of spruces and poplars. Professor Karl Sax will continue plant breeding work. A considerable number of crosses have been made between different species of apples, cherries, lilacs and other ornamental trees and shrubs.

Professor I. W Bailey, of the Bussey Institution, will spend the summer at the Biological Laboratory of the Carnegie Institution, Palo Alto, California. He has recently developed methods for removing tissue cells from trees, for keeping them alive and for studying them in the living condition Professor E. M East was at the Bussey Institution until July 15, carrying on investigations in the genetics of the genera Fragara, Nicotiana and Linaria. He now goes to the Jackson Memorial Laboratory at Bar Harbor, to prepare microscopical slides of hybrids in the genus Nicotiana He also has under way experiments which seek to determine whether or not plants have immunological reactions comparable to those shown by animals

In the department of botany, Professor E C Jeffrey will spend the summer collecting material for investigations on the relation of parthenogenesis to intimate processes in the cell. He will be in Cape Breton Island most of the time, gathering experimental and other material for this work Professor W H Weston will remain in Cambridge most of the summer, engaged in research and keeping in close touch with the graduate students and National Research fellows, and Assistant Professor R H Wetmore and Dr R H. Woodworth will conduct the summer school courses in botany During that period Professor Wetmore will continue the cytological investigations of the genera Aster and Soledago which he has been carrying on for some time Dr Woodworth will give attention to genetical and cytological studies with birches.

Dr C. W Dodge, curator of the Farlow Herbarium and Library, will spend the summer in Vermont, dividing his time between the manuscript of a book that he is writing on medical mycology and work on the mushroom flora of New England, undertaken by a committee of the Boston Mycological Club, of which he is chairman Professor Roland Thaxter, of the Farlow Herbarium, will continue the preparation of drawings and manuscript for the next volume of his monograph of the Laboulbeniaceae, at his summer home in Kittery Point, Maine

Professor M L Fernald, of the Gray Herbarium, accompanied on some trips by C A Weatherby, assistant at the herbarium, and on others by President A S Pease, of Amherst College, will visit localities in eastern America to study and collect little known plants Ernst C Abbe, graduate student, representing the Gray Herbarium, will join Noel E Odell, a former lecturer on geology at Harvard University, as guests of Professor Alexander Forbes, in a scientific survey of the high Torngat Mountains about Ryan's Bay in northernmost Labrador Dr Lyman B Smith, research fellow in botany, will continue, partly at the Gray Herbarium and partly in field work, his research for the Harvard Medical School on pollen flights and its relation to hay fever He is collaborating with Dr Francis M Rackemann, instructor in medicine at the school

SCIENTIFIC NOTES AND NEWS

DR. CHARLES FABRY, professor of physics at Paris, Dr. Emmanual de Margerie, professor of geology at Strasbourg, and Dr. Heinrich Wieland, professor of organic chemistry at Munich, have been elected foreign members of the Royal Society.

AT the meeting of the International Union for Scientific Investigation of Population Problems, held in London on June 15, Colonel Sir Charles Close, formerly director-general of the British Ordnance Survey, was elected president to succeed Professor Raymond Pearl, of the Johns Hopkins University The next general assembly of the union will be held in Germany in 1934.

THE Electrochemical Society has awarded the Edward Goodrich Acheson Medal for 1931 to Dr Edwin Fitch Northrup; it will be presented at the society's meeting in Salt Lake City on September 3. From 1903 to 1910 Dr. Northrup was secretary of the Leeds and Northrup Company, and from 1910 to 1920 assistant professor of physics at Princeton University. Since 1916 he has devoted himself chiefly to the development of high-frequency furnaces used for the melting of metals and alloys

THE Pharmaceutical Society of Great Britain announces that the Hanbury Memorial Medal for 1931 has been awarded to Professor Hermann Thoms, of Berlin The medal was founded in 1875 to commemorate Daniel Hanbury, a distinguished British pharmacist, and is awarded for "high excellence in the prosecution and promotion of original research in the chemistry and natural history of drugs" by a committee consisting of the presidents, for the time being, of the Chemical, Linnean and Pharmaceutical Societies, the chairman of the British Pharmaceutical Conference and one pharmaceutical chemist.

AT the commencement exercises of the College of

Wooster the honorary degree of doctor of science was conferred on Professor C G. Williams, director of the Ohio Agricultural Experiment Station.

THE degree of D C L has been conferred by the University of Durham on Dr Robert Muir, professor of pathology at the University of Glasgow

SIR SIDNEY F HARMER, formerly director of the natural history departments of the British Museum, has been elected an honorary member of the French Zoological Society

DR. HERMANN STIEVE, professor of anatomy at Halle, has been elected to membership in the Academy of Sciences at Upsala.

PROFESSOR W H HOFFMANN, of the Finlay Institute, Havana, has been elected a member of the International Leprosy Association

DR SAMUEL W STRATTON, chairman of the corporation of the Massachusetts Institute of Technology, formerly director of the Bureau of Standards, celebrated his seventieth birthday on July 18

DR PETER MUHLENS, professor of tropical medicine and hygiene at Hamburg, has been named professor *honoris causa* of the National University of Mexico

DR RUDOLF LADENBURG, of Berlin, has accepted an invitation to spend the next academic year at Princeton University

DR. W W JAMESON, professor of public health in the London School of Hygiene and Tropical Medicine, has been appointed dean of the school, in succession to the late director, Sir Andrew Balfour

DR CECIL EDGAR TILLEY, of Emmanuel College, has been elected professor of mineralogy at the University of Cambridge

DR CARL VON FABER, director of the Buitenzorg Botanical Institute, Java, has been called to the University of Vienna

DR. HERBERT F PRYTHERCH was recently appointed director of the station of the Bureau of Fisheries at Beaufort, North Carolina, and aquatic biologist in charge of South Atlantic oyster investigations In June, 1931, he received the degree of doctor of philosophy at the University of Pennsylvania after completing graduate research work under Dr C E McClung.

DR WILLIAM GERRY MORGAN, past president of the American Medical Association, and professor of gastro-enterology in Georgetown University School of Medicine for twenty years, has been appointed a member of the board of regents of the university

DR ALICE HAMILTON, assistant professor of industrial medicine at the School of Public Health of Harvard University, who recently received an Oberlaender Trust award, will study communicable occupational diseases in Germany

THE Board of Scientific Directors of The Rockefeller Institute for Medical Research announces the following appointments on the scientific staff *Associate,* Irvine Heinly Page, *Assistants,* Newell M Bigelow, Albert Claude, J Theodore Geiger, Harry S N Greene, Stanton A Harris, John L Jacobs, Esben Kirk, Douglas A MacFadyen, David K Miller, Ronald S Saddington, Henry W Scherp, Francis F Schwentker, Wendell M Stanley, Edward E Terrell, *Fellows,* James H Jensen, C William Lacaillade, Jr, Ralph G Schott, Lester W Strock, John E Stumberg, Peter S Yang The following promotions have been made *Associate to Associate Member,* Oskar Seifried, *Assistant to Associate,* George P Berry, Elmer E Fleck, Thomas Francis, Jr, Raymond C Parker, Robert E Steiger

DR. CHARLES A WATERS, associate professor of roentgenology at the Johns Hopkins Medical School, and Mrs Waters have sailed to participate in the third International Congress of Radiology in Switzerland

DR FRANCIS F LUCAS, metallurgist of the research staff of the Bell Telephone Laboratories, was the recent guest lecturer of the Henry Marion Howe Memorial, delivered under the auspices of the American Institute of Mining and Metallurgical Engineers, Iron and Steel Division, at the Engineering Societies Building

THE summer meeting of the American Astronomical Society will be held at the Perkins Observatory, Ohio Wesleyan University, Delaware, Ohio, on September 7, 8 and 9

THE American Public Health Association will meet from September 14 to 17, in Montreal. Special sessions will be devoted to toxoid immunization, health education, training of personnel, rural sanitation and British public health administration

AT the recent meeting of the American Society of Agronomy at Lafayette, Indiana, it was decided to hold the annual summer meeting at the University of Wisconsin in 1932 The present officers of the society are Dr W W Burr, dean of the Nebraska College of Agriculture, Lincoln, *president,* and Dr P E. Brown, of the Iowa State College of Agriculture, Ames, *secretary*

THE Second International Congress of Comparative Pathology will be held in Paris under the presidency of Professor C. Achard from October 14 to 18.

The subscription is 100 francs. Further information can be obtained from the General Secretary, M C. Grollet, 7, Rue Gustave Nadaud, Paris, XVIe.

THE *British Medical Journal* reports that the Ninth Congress of the International Society of Surgery will be held in Madrid from March 15 to 18, 1932, under the presidency of Professor de Quervain, of Berne, with Professor Recasens, of Madrid, as vice-president. Delegates from Austria, Germany and Hungary will again attend this congress The scientific program includes discussions on the diagnosis and treatment of intraspinal tumors, nontuberculous pulmonary suppuration, the surgery of the esophagus, and recent progress in the various forms of surgical anesthesia. It is proposed to arrange a tour starting from Irun on March 13, and visiting Madrid for the congress, thence proceeding to Toledo, Seville, Cordova, Granada, Valencia and Barcelona, with an excursion from the last-named to Monserrat The inclusive cost of this tour will be just under 4,000 francs, inquiries should be addressed to L'Agence Belge de la Compagnie Française du Tourisme, 29, Boulevard Adolphe Max, Brussels Further information about the congress will be supplied in due course by the general secretary, Dr L Mayer, 72, Rue de la Loi, Brussels

ACCORDING to *Nature* the Museums Association held its annual conference this year at Plymouth from July 6 to 11 All meetings of the association were held in the Abbey Hall July 6 was spent in committee meetings, and the president, Sir Henry Miers, delivered his presidential address on July 7 The president's address included some indication of a proposed survey of all the museums in the British Empire, to be financed by the Carnegie Corporation of New York Among the papers read were "A Suggested System of Museum Registration," by Mr K de B Codrington, and "Paper for Museum Labels," by Dr L J Spencer, on July 8, "Taxonomy in the Museum," by Dr W T Calman, "Present-day Problems of Provincial Museums," by Mr H J M Maltby, and "The Preservation of Marine Life, Wet or Dry Specimens," by Dr E J Allen, on July 9, and "Museum Problems in Canada," by Professor J H. Iliffe, "A Simple Way to Test Museum Value," by Dr Hay Murray, and "Why do we Use Plate-Glass in Museums?" by Mr Frank Loney, on July 10 All communications concerning the conference should be addressed to the local honorary secretary, Mr A J Caddie, Museum and Art Gallery and Cottonian Collection, Plymouth.

THE opening of the aviation wing of the New York Museum of Science and Industry was marked on July 13 at an informal luncheon in the aviation room Officials and representatives of the technical press attended. Alexander Klemin, head of the Guggenheim School of Aeronautics of New York University and technical adviser on the aeronautics section of the museum, was toastmaster and Dr Charles R. Richards, executive vice-president of the museum, outlined the general purposes of the industrial exposition The luncheon was concluded with an informal discussion of the problems of the new section of the museum and a preview of the exhibits

DR. VICTOR G HEISER, director for the East of the International Health Board of the Rockefeller Foundation, conferred recently in Tokyo with Dr Grand, of the foundation, and Dr M Miyajima, of the Kitasato Institute for Infectious Diseases, in regard to the endowment of a new school of Hygiene and Public Health in Tokyo The following special organization committee has been appointed *Advisers,* Dr Hayashi, dean of the medical department of the Tokyo Imperial University, Dr Kitajima, dean of the Keio Medical College, and Dr Teusler, chief of St. Luke's International Hospital, *Chairman,* Mr Akagi, chief of the Sanitary Bureau, *Commissioners,* Drs Nagayo and Miyagawa, of the Imperial University of Tokyo, and the Government Institute for the Study of Infectious Diseases, Drs Miyajima and Hata, of the Keio Medical College and the Kitasato Institute, Dr Sato of St Luke's International Hospital, and Drs Kusama and Noheji, of the Sanitary Bureau of the Home Ministry

THE will of the late Dr John Osborne Polak, professor of obstetrics and gynecology at the Long Island College Hospital, leaves $350,000 to the hospital, $100,000 for the erection of a science laboratory and $250,000 for a building for private patients for maternity and gynecological cases.

ACCORDING to the *British Medical Journal,* on June 24 the Royal Society of Tropical Medicine and Hygiene, whose first president was Sir Patrick Manson, moved into its new home in the Manson House, 26, Portland Place, London At present only the office and library are ready for occupation, but the other necessary alterations will be carried out as soon as possible, and a small hall for meetings is being erected at the rear of the building As a result of the appeal issued last year by the president, Dr. G. Carmichael Low, and Sir Austen Chamberlain, nearly £12,000 has been raised, but a further £17,000 is required to equip Manson House as a suitable headquarters where fellows when on leave or visiting England can meet and discuss with those at home the problems of tropical medicine and hygiene The society includes workers in tropical medicine in all parts of the world, with representatives of all the well-known centers and schools of tropical medicine. Donations will be gratefully acknowledged by the president if sent to him at Manson House, 26, Portland Place, W 1

THE Grenfell Association held a dinner at the Hotel Victoria, London, on July 2, when an appeal was made in aid of the endowment fund to carry on Sir Wilfred Grenfell's work in Labrador Sir George Broadbridge, who presided, said that the funds necessary to maintain the schools and hospitals, industrial centers and agricultural stations which Sir Wilfred Grenfell had started had come almost entirely as the result of his own personal appeal on his lecturing tours They felt that he should be relieved of the fatigue of these lecturing tours and so have greater freedom for the increasing claims of Labrador The supporters of his work in Canada, Newfoundland and the United States had raised an endowment fund of £120,000, and it was hoped to raise a sum in Great Britain worthy of the man and his work. Their aim was to secure at least £50,000 within the next three years as a fitting tribute to the life work of one of the most remarkable Englishmen of his day in the oldest British possession overseas.

THE General Assembly of Tennessee, the session of 1931, passed an act authorizing the Fish and Game Commission, which has jurisdiction and control of the lands and property on the shores of Reelfoot Lake, to set apart for the Tennessee Academy of Science some suitable building and such amount of lands adjacent to the Lake, not exceeding ten acres, for the establishment of a biological station for carrying on research work, the property and building to be under the management and control of the Academy of Science without the payment of rent or other payment to the state. The General Assembly also made an appropriation of $2,500 to be expended out of the Fish and Game Fund and rentals for state property around Reelfoot Lake by the Department of Fish and Game, under the commissioner of agriculture, for necessary buildings, plant outfit and grounds for the biological station.

DISCUSSION

THE BASIC SCIENCES AT THE CHICAGO CENTENNIAL EXPOSITION, 1933

THE city of Chicago having been incorporated as a village in 1833, a group of its leading citizens decided, some two or three years ago, to celebrate the centennial of this event by holding an international exposition This decision, however, was arrived at only after this group of gentlemen were thoroughly satisfied that they had a theme for an exposition which would make it not a mere repetition of other exhibitions, but a center to which people might come and discover for themselves a new view-point, a changed state of affairs This theme was found in the ministrations of pure science to industry and to society. The dependence of commerce and manufactures upon the results obtained in laboratories of science was considered a fascinating story, and something worthy of celebration The change from the covered wagon to the Pullman car, the substitution of the air-plane for the pony express, the increased leisure and the higher plane of living, all of which came in the wake of these advances in science, combine to make the story a fitting theme for a world's fair

The achievements of pure science having been adopted as the central motive of the exposition, the president, Mr Rufus C Dawes, promptly invited the National Research Council to suggest what line of scientific results might best be shown in order to demonstrate this principal thesis of the fair. The response to this invitation was generous. It took form in the appointment of an advisory committee and various subcommittees whose reports are now guiding the spirit and the arrangement of the exhibits in the field of pure science.

The division of basic sciences falls in the department of exhibits and, for convenience of operation, is subdivided into five sections as follows:

Division of Basic Sciences
- 1—Astronomy
- 2—Physics and mathematics
- 3—Chemistry
- 4—Biology, including psychology
- 5—Earth Sciences, including geology, geography and geodesy

Anthropology and psychology, each of them a biological science, will be grouped together as they are in the organization of the National Research Council, but they will probably be shown in a building other than the hall of the basic sciences. This separation is a mere matter of convenience in securing the proper space for these two large fields of investigation

In presenting the basic sciences to the visitors of 1933, the plan of the administration is to forget questions of nationality and to make the entire exhibit thoroughly cosmopolitan and international. The important discoveries in each science are to be set forth in their proper sequence regardless of the places where and the men by whom they were made. Easily read legends will set forth not only the fundamental idea of each exhibit but also, in many cases, our indebtedness to the individual investigator.

Another distinct feature will be the presentation of phenomena and processes of the basic sciences, rather than mere apparatus or even results which have been obtained by use of apparatus That this is no simple undertaking will be evident to every one To demonstrate, on the lecture table, a chemical reaction in the presence of a class is one thing, to maintain this process in continuous operation for one hundred and fifty days is quite another thing To demonstrate the phenomena involved in some vital process in the laboratory, perhaps on the stage of a microscope, for a few minutes, is one thing, to keep the phenomena visible to a large number of visitors for a period of five months is something quite different. To what extent these dynamic exhibitions can be substituted for the static ones so largely employed hitherto must be left for the future to decide Whatever is possible in this direction will be achieved largely by the aid of clever, generous and wise advice from various leaders of science who have in the past so freely given valuable suggestions and help

The inherent difficulty of making clear an intellectual advance by purely material means, plus a few printed legends, is something which needs only to be stated in order to be appreciated Curiously enough, exposition becomes especially arduous in those very fields, such as algebra and quantitative physics, which lend themselves so readily to description in mathematical symbols Since the main goal of the Chicago Centennial is a demonstration of the indebtedness of society to science, nothing in the way of a stated course in science will be offered, on the other hand, it is hoped that the exhibits, even in the pure sciences, will furnish entertainment and inspiration as well as instruction

The Department of Exhibits, which is under the direction of Mr John S Sewell, includes besides the basic sciences six other divisions, namely those of applied science, of which Mr J F Bell is the chief, agriculture, in charge of Mr Harvey J Sconce, social science, at the head of which is Professor H W Odum, state and federal participation, in charge of Mr C. Van Deventer, foreign participation, at the head of which is Mr. Felix J. Streyckmans, and fine arts, which has not yet been organized The entire executive responsibility of the fair has been placed upon Mr. Lenox R Lohr, who is manager of the exposition; but responsibility for the preparation and installation of exhibits in the basic sciences is in the hands of the following. chief of division, Professor Henry Crew, associate in astronomy, Professor Philip Fox; associate in physics and mathematics, Dr Gordon S. Fulcher; associate in chemistry, Dr Irving Muskat, associate in biology, Mr. J F W. Pearson, associate in geology, Professor J. V Lewis.

The plans of the division of the basic sciences include also the publication of a series of small volumes devoted to the latest phases of some twenty branches of science, pure and applied The authors are well-known scholars The series will be handled by the Waverly Press, Williams and Wilkins

Readers of SCIENCE have already learned that the American Association for the Advancement of Science will hold its summer meeting for 1933 in Chicago A considerable number of foreign scholars in each section of the association are being invited for this occasion

JOHN STEPHEN SEWELL,
Director of Exhibits

THE WORK OF CHINESE BOTANISTS ON THE FLORA OF CHINA

IT is interesting to note the efforts that the younger generation of Chinese botanists are devoting to the further elucidation of the very rich and complex flora of China This work by Chinese botanists under the auspices of Chinese institutions has been developed within the last two decades There has recently been issued under the joint auspices of the Metropolitan Museum of Natural History, Nanking, and the Fan Memorial Institute of Biology, Peiping, an important contribution to our knowledge of the fern flora of China[1] The volume is large quarto in size, and contains full descriptions in English and in Chinese, and illustrations, of fifty-one species of Chinese ferns, including a number recently described as new by Mr. Ching The format, typography and press work is good The very excellent illustrations showing both macroscopic and microscopic characters renders this publication particularly useful to those interested in the study of Chinese ferns This important work deserves a place in every botanical library

E D MERRILL

NEW YORK BOTANICAL GARDEN,
NEW YORK, N Y

EXPONENTS AND FOOTNOTES

THE writer has long wondered whether an alternative could not be devised for the now very general practice of applying Arabic numerals to footnotes, and indicating their place of reference in the text by numbers typographically identical with those employed as exponents In a vast majority of cases, of course, no confusion results from this procedure Either no mathematical formulae are present in a paper, or the context makes it evident, in a given case, whether or not we have to do with an exponent But in some instances this is not true. Exponent and footnote reference numbers may occur together on adjacent lines, set in the same type, and having approximately the same magnitudes (I have just such a case before me in a recent issue of an important journal)

---

[1] H. H Hu and R C Ching, "Icones filicum sinicarum," Fasc 1, p. 1–102, pl 1–50, 1930

Until a few months ago, however, this danger of confusion was, in my own case, rather an academic possibility than an actual experience But it was realized in a rather disastrous way in a recent scientific paper of mine On one page of this paper[1] occur two footnotes (numbered 1 and 2), likewise two fractions bearing exponents The first of these, which should have been $(\frac{4}{5})^3$, has been printed $(\frac{4}{5})^1$ The second, which should have been $(\frac{5}{6})^4$, actually reads $(\frac{5}{6})^2$ These typographical errors result not only in errors of elementary arithmetic, but they render unintelligible the discussion of a rather important phase of my subject, both on this and later pages of the text The source of these errors, on the printer's part, seems obvious

Is it unreasonable for me to suggest that reference numbers (or letters) to footnotes should be set in entirely different type from those employed as exponents?

F B SUMNER

SCRIPPS INSTITUTION OF OCEANOGRAPHY

COLOR

BY some mistake which neither the editor nor I can explain, the last part of my note on "Color" in SCIENCE for May 8, p 495, was omitted The portion omitted follows

(6) If the physiological elements in the retina which respond to red light are missing, the phenomenon ends here and the sensation of red is not excited.

(7) If the eye is normal, the sensation is transmitted to the brain and mind by a process still entirely physical or chemical but evidently quite different from that by which the light has been transmitted to the eye.

(8) In the brain and mind the sensation of red is produced Some think the phenomenon is still physical or chemical, but no one has been able to suggest any definite picture of the processes in the mind as physical phenomena

(9) The name given to the sensation depends on previous comparisons which the individual has made with the aid of others If he is an American he will call the sensation red A Frenchman will call it rouge, a German, roth.

It is evident, therefore, that color is a complex phenomenon including many diverse elements no one of which can be omitted if the phenomenon is complete.

Durant in his "History of Philosophy" defines philosophy as "the synthetic interpretation of all experience" and seems to wish to delimit science as including only analysis and description Most scientific men will agree, I think, that science which includes only analysis and description is of a low order To be of much value it must rise above that to coordination and synthesis. In these higher reaches science and philosophy should become identical.

What has been given above may be called a scientific philosophy of color

W. A. NOYES

HEIDELBERG, JUNE 11, 1931

SPECIAL CORRESPONDENCE

GRANTS-IN-AID OF THE NATIONAL RESEARCH COUNCIL

AT its meeting in June the National Research Council's Committee on Grants-in-Aid made grants for the support of research as follows

To Charles W Jarvis, associate professor of physics, Ohio Wesleyan University, critical potentials of mercury vapor, C. E Mendenhall, professor of physics, University of Wisconsin, photoelectric characteristics of metals, S A Mitchell, director, Leander McCormick Observatory, University of Virginia, the measurement of the proper motion of the stars for the determination of parallax, Louis A. Turner, associate professor of physics, Princeton University, temperature distribution and metastability of vibration and rotation states of iodine molecules; Peter I. Wold, professor of physics, Union College, electrical properties of expanded mercury, with special reference to the Hall effect and to conductivity.

To Gleason W. Kenrick, assistant professor of electrical engineering, Tufts College, statistical study of field intensities in the low frequency region of the radio spectrum.

To Wilder D Bancroft, World War Memorial professor of physical chemistry, Cornell University, the application of physical chemistry and colloid chemistry to biological and medical problems; Harry N. Holmes, professor of chemistry, Oberlin College, concentration of vitamin A and other vitamins.

To Arthur Keith, geologist, United States Geological Survey, investigations of portions of northern Maine and of New Brunswick to determine the existence of two periods of mountain building, Lewis B. Kellum, assistant professor of geology, University of Michigan, reconnaissance of a belt of cross-folding in the Sierra Madre mountains of Mexico; K C McMurry, associate professor of geography, University of Michigan, land survey of Isle Royale; Jerome S. Smiser, instructor, department of geology, Princeton University, collection and description of the echinoids in the Cretaceous rocks of the Big Bend Trans Pecos, Texas, H B Stenzel, assistant professor of geology, Agricultural and Mechanical College of Texas, the paleontology and stratigraphy of the *Lower Claiborne group in Leon County, Texas*, Stephen Taber, professor of geology and mineralogy, University of South Carolina, structural geology of the land areas adjacent to the Bartlett trough

---

[1] *Journal of Genetics*, November, 1930, p. 307. Barring these unfortunate, but easily comprehensible errors, the press work was exceptionally fine.

To Morris G Leikind, School of Hygiene and Public Health, Johns Hopkins University, lymphocystic disease of fish, Clarence A Mills, professor of experimental medicine, University of Cincinnati, temperature adaptation in animals, William C Rose, professor of physiological chemistry, University of Illinois, nutritive importance of the amino acids, Leo T Samuels, assistant professor of biological chemistry, and Howard A Ball, instructor in pathology, College of Medical Evangelists, the relationship between the hypophysis and the growth of autogenous and transplanted malignant tumors in animals, Charles W Turner, associate professor of dairy husbandry, University *of Missouri, the hormone of* lactation of the anterior pituitary, George D Williams, assistant professor of anatomy, Washington University, accurate determination of skin color

To Bennet M Allen, professor of zoology, University of California at Los Angeles, the influence of the thyroid gland and hypophysis upon growth and development; L. R Cleveland, assistant professor of protozoology, Harvard Medical School, phylogenetic relationships of the intestinal protozoan parasites of termites and other primitive insects, Ernst Gellhorn, associate professor of physiology, University of Oregon, comparative physiology of ion antagonism and ion effects in fatigued muscles, LaDema Mary Langdon, assistant professor of biology, Goucher College, comparative study of the embryogeny of Juglandaceae and Fagaceae, Manley L Natland, Long Beach, California, ecological conditions of foraminifera and mollusca, Will Scott, professor of zoology, University of Indiana, distribution of the finger nail clams of Indiana, Paul B Sears, professor of botany, University of Oklahoma, pollen analysis of Arkansas peats

To Sophie de Aberle, instructor in anthropology and obstetrics, Institute of Human Relations, Yale University, growth and development in Indian children in New Mexico and Arizona, William R Morse, dean of the College of Medicine and Dentistry, West China Union University, Chengtu, West China (at present at the Peabody Museum, Harvard University), anthropology of the inhabitants of the Province of Szechwan, West China, Elsie Murray, instructor in psychology, Cornell University, partial color-blindness, Jessie W Murray, acting director, Tioga Point Museum, investigations of aboriginal Indian sites near Athens, Pennsylvania, E Sapir, professor of anthropology and general linguistics, University of Chicago, the collection of the songs of the Nitinat Indians of Vancouver Island

VERNON KELLOGG,
Permanent Secretary,
National Research Council

SOCIETIES AND MEETINGS

THE TEXAS ACADEMY OF SCIENCE

THE Texas Academy of Science held its spring meeting at Austin on June 5, where it was the guest of the Faculty Science Club. The occasion for this meeting was the conferring of life fellowship upon those who remained of the group of men who founded the academy on January 9, 1892. The session began on Friday afternoon with an inspection of the various laboratories and collections of the university. The visiting chemists were given a "preview" of the new chemistry building, which when completed will be one of the finest in the South The various collections belonging to biology, botany, geology and anthropology drew their quota of visitors. At 7 P. M. a dinner was served at the University Commons to one hundred and twenty-five members and guests The program which followed consisted of a greeting to the academy from the president of the university, Dr H Y Benedict, who also represented the Faculty Science Club. Dr. F. W. Simonds gave a history of the first ten years' work of the academy, which told of the struggles to gain for it the recognition of the scientific world.

J. Kern Strecker, president of the Texas Academy of Science, presented certificates of life membership to the following members J R Bailey, professor of organic chemistry, University of Texas, H. Y. Benedict, president, University of Texas, James T. Clark, Texas Land Office, A Judson, M D, Houston, Texas, F. W Simonds, professor of geology, University of Texas, and R A Thompson, highway engineer, Dallas. In presenting these certificates, President Strecker gave a history of each recipient, and stated that of the fourteen men who on January 9, 1892, founded the academy, six were dead, the whereabouts of one unknown and the remaining seven were present The responses to the president's presentation speech were much appreciated by those present Dr H. Y Benedict expressed the hope that, as one half of the original founders were present at the fortieth anniversary, one half of those who reorganized the academy would be present at the eightieth anniversary.

The secretary, H B Parks, San Antonio, gave a short résumé of the accomplishments of the past three years and the plans for the work of the immediate future.

The lecture of the evening consisted of a talk by Dr J M Kuehne on colored photography, which was illustrated by some two hundred slides The colored photographs told the story of the wild flowers of Texas through a single season, beginning with winter and spring flowers and ending with the composites of the autumn Of special interest were the photographs of species that are common in Texas in early spring, which were blooming along the edge of the snow-cap of Mt Rainier in August

A meeting of the executive committee at the close of the program selected Dr F McAllister to represent the academy at the Pasadena meeting of the American Association for the Advancement of Science

H B PARKS,
Secretary

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE annual meeting of the New Hampshire Academy of Science was held May 29 and 30, 1931, at Littleton, New Hampshire

On Friday night, May 29, the academy was addressed by Mr. Arthur H. Norton, curator of the Portland Society of Natural History, on "Shore Mammals of Northern New England." Slides showing specimens and illustrations collected by Mr. Norton in his many years of work with the shore fauna of northern New England were shown

On Saturday morning, May 30, Mr Henry Helm Clayton, formerly of the Argentine Weather Bureau and the Smithsonian Institution, now consulting meteorologist, gave an address on "Long Range Weather Forecasting from Variations in Solar Heat," illustrated by graphs and charts Papers by members of the academy were read and discussed at the remainder of the morning session

The afternoon was given over to an excursion to the new power plant and dam of the Grafton Power Company at the Fifteen Mile Falls on the Connecticut River, about twelve miles from Littleton This hydro-electric project, developing 250,000 horse power, is the second largest in New England, and has just gone into operation

After the business meeting on Saturday night, the retiring president, Dr C H Dolloff, delivered the presidential address, "The Present Status of Psychiatry," after which the papers by the members remaining on the program were read and discussed

At the business meeting, among other matters, the academy voted to have the executive council consider the project of a junior academy of science

Officers for 1931–1932 elected were

President, Professor James W Goldthwait, geology department, Dartmouth College

Vice president, Professor Norman M Gilbert, physics department, Dartmouth College

Secretary Treasurer, Professor George W White, geology department, University of New Hampshire

Member of the Executive Council, Dr Charles H Dolloff, Superintendent, New Hampshire State Hospital.

GEO W WHITE,
Secretary-Treasurer

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE GRINDER FOR SOFT TISSUES

THE tissue grinders now available are subject to one or more of the following disadvantages (1) they are so expensive that most laboratories can not stock them in quantity, (2) they must be sterilized immediately before using, so that much time is lost between the removal of the tissue and its grinding, (3) there is danger of contaminating the tissue from the air or from the hands of the worker, and (4) danger to the worker from contact with infected tissue. In the commonly used mortar and pestle the last two disadvantages are especially marked For some years we have been using a type of grinder, not subject to these disadvantages, which may be useful to other laboratory workers

The suggestion for the grinder came from Hagan,[1] who used two test-tubes that fitted one into another.

---

[1] W. A Hagan, *J. Exp Med.*, 36 722, 1922.

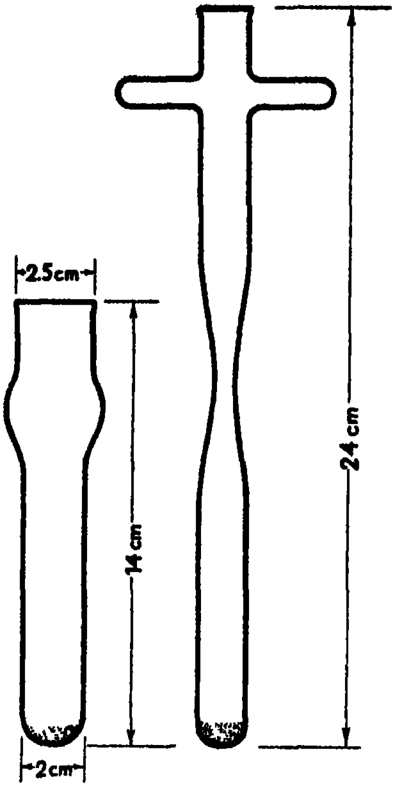


Fig 1

We have modified it as shown in the sketch (Fig 1) and have had it made of Pyrex glass to decrease the danger of breakage. A bulb holds the ground tissue and the salt solution used for suspending it. The plunger, which has been lengthened to prevent contamination of the top of the tube, has also been constricted to make the introduction of fluids easier. The projections on the top of the plunger make handles that can be easily grasped. The plunger must fit the inner side of the tube snugly but not so tightly as in a syringe. The bottom of the plunger is ground to fit the tube accurately, and the two should be numbered so that they can always be matched. The dimensions given are those we have found useful, but they may be modified according to the amount of tissue usually ground.

Since these grinders, when made in small quantities, cost about three dollars, a number can be kept on hand ready for use. The outer tube and plunger are sterilized separately, the former is plugged and capped, while the latter is inserted up to the cross pieces in a large plugged test-tube. The outer tube is then ready to receive tissue from an autopsy, and when convenient the sterile plunger can be inserted and the tissue ground. Salt solution or other diluent may be introduced with a pipette. The danger of contaminating the tissue or the hands of the worker is slight.

Since this grinder operates largely by pressure, organs containing much connective tissue can not be readily emulsified in it. Soft tissues, such as rabbit or guinea-pig spleen, liver, or brain, can, however, be rapidly ground to such a fine state that when diluted with an equal amount of salt solution they will pass through a No 20 needle. It is sometimes necessary to remove coarse particles, which would plug the needle, by slow centrifugation. Cultures for bacterial counts or to secure isolated colonies from infected material can be made from the emulsions.

Recently we have found these grinders very useful for preparing chick embryo emulsions to be used in the Li-Rivers' method[2] of cultivating filtrable viruses, and for the preparation of uniform emulsions of dried tissues containing viruses.

Carl TenBroeck
Department of Animal Pathology,
The Rockefeller Institute for
Medical Research,
Princeton, New Jersey

A SIMPLE APPARATUS FOR WASHING PROTOZOA

A simple method of washing Protozoa and other small objects in running water has proved so satisfactory in my own work that I believe other investigators may also find it useful. Its chief virtue lies in its simplicity.

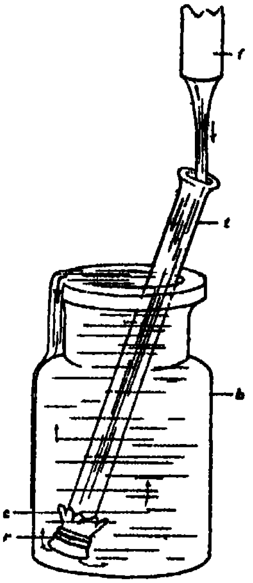
The apparatus described below is a modification of that used by Caullery and Chapellier as given by Langeron.[1] All that is needed is a section of glass tubing of convenient size, a scrap of bolting cloth, a rubber band and a bottle. The accompanying diagram will illustrate the set-up. A section of glass tubing (t) about 8 cm long and 5 or 6 mm inside diameter is heated at one or both ends and spread slightly after the manner of the bulb end of an ordinary pipette. A piece of bolting cloth (c) is tightly fastened over an enlarged end of the tube by means of a rubber band (r). No 20 silk bolting cloth has proved quite satisfactory for average size Protozoa, while No. 25 serves for the smaller forms. This procedure is probably not suitable for the very smallest organisms.

The tube is placed, covered-end down, in a small bottle (b) of a size and shape that will allow the tube to extend well above the mouth, and provide a reasonably steady base. The organisms to be washed are placed in the tube by means of a pipette. As soon as the fluid has drained from the tube into the bottle a small stream of water is allowed to flow into the tube, directly from the faucet (f) if the bottle can be placed within a few centimeters of it, or via an extension of rubber tubing, the end of which is supported a short distance above the glass tube. This procedure maintains a steady flow of fresh water over the material being washed as the column of water between the mouth of the bottle and the upper end of the tube exerts just enough pressure to cause a gentle flow through the tube. The waste escapes over the mouth of the bottle

---

[2] C P Li and T M Rivers, *J. Med Exp*, 52: 465, 1930.

[1] M. Langeron, "Précis de Microscopie," Maison et Cie, Paris, 1925.



Modifications may easily be made to suit special needs For example, if the tap water contains much foreign matter it may be strained by leading it through bolting cloth of finer mesh than that holding the organisms, before it is allowed to pass into the tube

After washing, the material may be transferred to centrifuge or settling tubes for further manipulation. If preferred, it may be stained and dehydrated before removing from the apparatus by merely pipetting in the various fluids to be used, or by transferring the tube containing the organisms from one bottle to another containing the required reagents

JOHN P TURNER

UNIVERSITY OF MINNESOTA

SPECIAL ARTICLES

X-RADIATION AND REGENERATION IN AMBLYSTOMA

IT has been demonstrated within the past few years, especially by the work of Curtis[1] and his students, that x-radiation affects very markedly the regenerative activity in certain invertebrates Coelenterates, planarians and annelids, for example, which under normal conditions readily regenerate lost parts, lose their capacity for regeneration when subjected to the influence of x-rays Although considerable work has been done on the influence of x-radiation on regeneration in invertebrates, so far as the writer is aware no observations have been published on the effects of x-rays on the regenerative activity in vertebrates.

During the past two years the writer has conducted a series of experiments which deal with the effects of x-radiation on regeneration in embryos of Amblystoma, especially on regeneration of the fore limb. The fore limb of this animal is a convenient structure for use in experimental studies on regeneration, for the reason that under ordinary conditions it is very readily regenerated, and in embryonic stages of Amblystoma the regeneration takes place rather rapidly The results of all experiments to date show conclusively that x-radiation in proper dosage will prevent normal regeneration of the limb in any stage of limb development.

When the limb bud is amputated at a very early stage of development, the amputation consists in the removal of merely the small mesodermal bud and its ectodermal covering The wound heals quickly and, under normal conditions, regeneration of the limb bud and subsequent normal limb development takes place However, the limb will fail to regenerate after amputation, if the embryo be given daily dosages of x-rays Some growth takes place and a short spur-like appendage develops; but differentiation into upper arm, forearm and hand does not occur. Radiation appears to prevent differentiation during regenerative growth.

It is especially striking that a dosage of x-radiation which very definitely prevents limb regeneration has no apparent effect on normal limb growth and differentiation. If, for example, the limb bud on one side of the body is amputated at an early stage of limb development, and the embryo is radiated daily, the limb will fail to regenerate except for the development of a short spur-like appendage. In the same embryo, however, the unharmed limb bud on the opposite side of the body will grow and develop into a normal limb, apparently unaffected by the radiation. Other experiments, also, demonstrate this same phenomenon. For example, daily radiation of Amblystoma embryos has been begun in the blastula stage and continued during a period of over seven weeks. Embryos so radiated appear to develop normally, and limb growth and differentiation takes place in an apparently typical manner. However, if at any time during the course of the experiment a limb is amputated, it will not be regenerated; at the same time the unharmed limb on the opposite side of the embryo will continue normal development

---

[1] W. C Curtis, "Old Problems and a New Technique," SCIENCE, 67: 141–149, 1928.

By means of x-radiation, regeneration can be as effectively prevented in late stages of limb development as in early stages. If an embryo, the fore limb of which is well developed into upper arm, fore arm and hand, be given daily dosages of x-rays no portion of the limb will be regenerated after amputation. This failure to regenerate under the influence of x-radiation occurs, moreover, regardless of the level at which the limb is amputated. The wound at the point of amputation heals as quickly as in normal unradiated controls, and there is a slight amount of growth at the cut end However, there is no regeneration of the lost part such as takes place rapidly in unradiated embryos. The effect of x-radiation in preventing regeneration, therefore, appears to bear no relation to the age of the embryo, the stage of limb development, or the level at which the limb is amputated

One of the significant results of this investigation is that x-radiation affords a method of studying experimentally the differentiation process in regeneration as compared with differentiation in normal embryonic development It would appear that the differentiation during regeneration is in some important respect unlike the differentiation during normal development, the former is prohibited by a dosage of x-radiation that has no externally visible effect on the latter Histological studies of non-regenerating limbs of Amblystoma embryos compared with normally regenerating limbs are now in progress

The source of radiation for these experiments was a Coolidge medium focus tube. The factors governing the dosage of radiation were as follows 65 kilovolts, 7 milliamperes, distance from target to embryo 25 cm, exposure from 3 to 5 minutes

ELMER G. BUTLER
LABORATORY OF COMPARATIVE ANATOMY,
PRINCETON UNIVERSITY

EFFECTS ON THE GONADS OF CORTICO-ADRENAL EXTRACT[1]

AN apparent interrelationship between the adrenal cortex and the sex glands has frequently been noted by clinicians.[2,3] The fact that both tissues arise from a common mesodermal origin, and that hypertrophy of the adrenal cortex occurs in pregnancy and in sexual precocity, has strengthened this view No adequate experimental evidence in confirmation of the hypothesis appears, however, to have been brought forward.

In an attempt to secure data relative to this possible interrelationship, immature albino rats were injected intraperitoneally with cortico-adrenal extract prepared in this laboratory according to the method of Swingle and Pfiffner[4] This extract has been shown to contain the cortical hormone in sufficient amount to maintain adrenalectomized cats in good health for considerable periods of time, and to revive animals showing marked symptoms of adrenal insufficiency[5] Litter mates which were used as controls were injected with corresponding amounts of normal saline solution All animals used were of Wistar stock. They were fed on a standard meal diet

Following one and two-week periods of treatment, the animals were killed and the gonads fixed in Bouin's solution Identical methods of fixation, clearing and staining were employed in order that the observations might be in every way comparable The results of the treatment are summarized in the accompanying table

When histological preparations of the gonads were compared in all animals from the 25-day stage onward, it was observed that maturation of the experimental gonad, considerably beyond that seen in controls of the same age, had taken place In the female this was evidenced by a greater amount of fluid within the follicles, and by increased follicular diameter In the male, the difference was not so striking The tubules of the experimental animals presented a more closely packed appearance, and a reduction and increased differentiation in the cells of the germinal epithelium was apparent The general appearance was quite similar to that seen in young rats, following the injection of macerated pituitary gland[6] The cortico-adrenal extract used, it should be mentioned, was in all cases sterile and protein free, and contained approximately 1 in 4,000,000 parts of adrenalin.

In several cases marked uterine enlargement was produced by cortico-adrenal extract injection The

---

[1] Reported in brief at the meeting of the Federation of American Societies for Experimental Biology, Montreal, April 11, 1931.

Grateful acknowledgment is made of aid in the above investigations by the Grants-in-aid Committee of the National Research Council.

[2] W. Bullock and J Segueira, *Trans* Path Soc. London, 56: 189, 1905

[3] L. Guthrie and W d'E Emery, *Trans* Clin. Soc London, 40. 175, 1907.

[4] W. W Swingle and J. J. Pfiffner, *Anat Rec.*, 44: 225, 1929; *Am Jour. Physiol.*, 95 153, 164, 1931.

[5] S. W. Britton and Herbert Silvette, SCIENCE, 73 322, 373, 1931.

[6] E. L. Corey, *Physiol Zool.*, 3 379, 1930.

Number of animals used	Age (days)	Daily dosage	Equivalent in fresh glandular substance (grams)	Duration of period of injection		Results in experimental animals*
4	18	¼ cc	7.5	1 wk	(2)	Negative
				2 wks	(2)	"
4	20	2 cc	60.0	1 wk	(2)	"
				2 wks	(2)	"
4	25	½ cc	15.0	1 wk	(2)	"
				2 wks	(2)	"
4	32	¼ cc	7.5	1 wk	(2)	"
				2 wks	(2)	Corpora lutea present
4	33	4 cc	120.0	1 wk	(4)	Corpora lutea present
4	35	1 cc	30.0	1 wk	(4)	Spermatogenesis Corpora lutea
2	42	1 cc	30.0	1 wk	(2)	Spermatogenesis Corpora lutea

* Corpora lutea were present in none of the control animals. At the 42 day stage, however, a small percentage of the tubules of the controls contained a few spermatozoa.

pituitary gland also showed considerable hypertrophy in some of the youngest animals examined.

It is concluded that extracts of the adrenal cortex, which contain according to recent observations the hormone of the cortical tissues, produce precocious sexual maturity in the albino rat. The effect is most pronounced and first produced in the female.

E. L. Corey
S. W. Britton

Physiological Laboratory,
University of Virginia

ANTIUREASE[1]

Antienzymes, such as antirennin, antipepsin, antitrypsin, anticatalase, antiemulsin, antiamylase and others, have been described in enzyme literature, but there always has been considerable doubt of their existence. In some cases, as with anticatalase, the substance is nothing more than an inhibitor occurring naturally in animal tissues. The production of antipepsin by injecting pepsin into animals is very improbable since pepsin is rapidly destroyed at the pH of the blood.

We believed that crystalline urease would be especially suitable for the production of an antiurease in animals for the following reasons. It is extraordinarily active, it is stabilized by blood serum and it poisons animals even in small doses by converting the animal's urea to ammonium carbonate.

Urease, recrystallized from 30 per cent. alcohol and of the highest obtainable activity, was injected into young rabbits of from 2 to 2½ kilograms in weight. When given by ear vein as little as 0.3 mg caused convulsions after a few minutes and death after 1 or 2 hours. When the urease was injected intraperitoneally the rabbit was usually found dead in 10 to 12 hours. Subcutaneous injection caused death within 36 to 48 hours. It has been possible to immunize rabbits by starting with subcutaneous, or intraperitoneal injections of 0.02 to 0.04 mg and increasing the dose gradually. The amount of urease has been increased as high as 4 or 5 mg of crystalline urease at a single injection without causing any loss in weight and any visible symptoms other than slight swellings at the sites of injection. Serum from these immunized rabbits, when incubated with crystalline urease, greatly inhibits the ability of the urease to hydrolyze urea. Even as little as 0.015 cc of the immune serum has an unmistakable effect. When normal rabbits are given protective doses of immune serum intraperitoneally, they have been shown to be unaffected by twice the lethal dose of crystalline urease.

Since antiurease can be determined easily by chemical means and, unlike toxin-antitoxin, is independent of animal experimentation for its demonstration and estimation, we expect this work to lead eventually to a more complete understanding of the phenomena of immunological reactions.

James B. Sumner
J. Stanley Kirk

---

[1] From the Department of Physiology and Biochemistry, Medical College, Cornell University, Ithaca.

BOOKS RECEIVED

Brownell, Herbert. *Physical Science.* Pp. xiv + 813. 125 figures. McGraw-Hill. $2.50.

Jones, Henry A. and Samuel L. Emsweller. *The Vegetable Industry.* Pp. viii + 431. 154 figures. McGraw-Hill. $2.25.

Millard, E. B. *Physical Chemistry for Colleges.* Third edition. Pp. ix + 522. 87 figures. McGraw-Hill. $3.75.

National Research Council of Japan. *Japanese Journal of Geology and Geography.* Transactions and Abstracts. Volume VIII. No. 4. Pp. ii + 241 + 359. Illustrated. The Council, Tokyo.

Shirley, Mary M. *The First Two Years, a Study of Twenty-Five Babies.* Volume I. Postural and Locomotor Development. Pp. xv + 227. 15 figures. 10 plates. University of Minnesota Press. $2.00.

Ting, V. K. and Y. C. Sun, editors. *Palaeontologia Sinica.* Series D, Volume VII, Fascicle ii: On an Adolescent Skull of Sinanthropus Pekinensis in Comparison with an Adult Skull of the Same Species and with Other Hominid Skulls, Recent and Fossil, by Davidson Black. Pp. 144 + viii. 16 plates. 37 figures. The Geological Survey of China, Peking.

Yonge, C. M. *A Year on the Great Barrier Reef.* Pp. xx + 246. 69 plates. 17 diagrams. Putnam. $6.00.

SPECIAL ISSUE CONTAINING REPORTS OF THE FIRST PASADENA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES. EDITED BY DR CHARLES F ROOS, PERMANENT SECRETARY

SCIENCE

VOL 74 FRIDAY, JULY 31, 1931 No 1909

The American Association for the Advancement of Science, Reports of the First Pasadena Meeting of the American Association for the Advancement of Science and Associated Societies

General Features 103
Attendance, Sessions and Papers 104
The Local Committee and Representatives of Sections 104
Officers of the Association for the Calendar Year 1931 105
General Reception and Entertainment 106
Excursions 106
Meetings of the Council 106
The Scientific Exhibition 107
General Sessions 108
The Press Service 109
Scientific Sessions 110
Section A (Mathematics) 110
Section B (Physics) and Related Organizations 110
Section C (Chemistry) and Related Organizations 113
Section D (Astronomy) 113
Section E (Geology and Geography) and Related Organizations 114
Section F (Zoological Sciences) and Related Organizations 115
Section G (Botanical Sciences) and Related Organizations 116
Organizations Related to Both Sections F and G 117
Section H (Anthropology) and Related Organizations 117
Section I (Psychology) and Related Organizations 118
Section K (Social and Economic Sciences) and Related Organizations 119
Section L (Historical and Philological Sciences) and Related Organizations 120
Section M (Engineering) 121
Section N (Medical Sciences) and Related Organizations 121
Section O (Agriculture) 122
Section Q (Education) 122
Obituary
Edward Hart PROFESSOR EUGENE C BINGHAM
Shibasaburo Kitasato MIKINOSUKE MIYAJIMA
Recent Deaths 123
Scientific Events
The British National Collection of Type Cultures, The New Observatory of the University of Kentucky, Summer Session of Teachers of Chemical Engineering, The Schenectady Meeting of the American Physical Society, The Filterability of Bacteria 126
Scientific Notes and News 128
Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

GENERAL REPORTS OF THE FIRST PASADENA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

GENERAL FEATURES

THE eighty-eighth meeting of the American Association and associated societies at Pasadena, California, from June 15 to 20, 1931, inaugurated a new series of national summer meetings and set many precedents which will undoubtedly make all future meetings of the association more interesting and enjoyable. Too much credit can not be given the local committee for its wealth of ideas and its endeavors to make this meeting interesting Much emphasis was placed on important symposia by distinguished scientists who came from twenty-eight states and nine foreign countries A preliminary announcement for this meeting was mailed out to all members of the association about four weeks in advance of the meeting and a more condensed announcement containing some additional information appeared in SCIENCE for May 15, 1931

The sessions of the association and associated societies were very satisfactorily accommodated in the buildings of the California Institute of Technology, the Mount Wilson Observatory, the Southwest Museum and the Huntington Hotel

The president for this summer meeting of the association was Professor Franz Boas, of Columbia University Professor Boas is known throughout the world for his important contributions to anthropology and is frequently called the dean of American Anthropologists The association is greatly indebted to him for his loyalty and willingness to postpone his summer trip so that he could be present at the meeting.

The retiring president for the Pasadena meeting was Professor Thomas Hunt Morgan, of the California Institute of Technology, eminent leader in zoological research and teaching and a pioneer in genetics research Dr Morgan introduced the new president, Dr Boas, at the first of the evening sessions.

ATTENDANCE, SESSIONS AND PAPERS

Fourteen of the fifteen sections of the association were officially represented on the program, and twenty-two independent organizations of scientific workers joined with the association on this occasion Altogether about 110 scientific sessions were held, and about 580 papers and addresses were delivered by about 525 individuals

Eleven hundred and ninety-three persons were actually registered at the association's registration offices as in attendance Many present did not register, and it is therefore impossible to tell how many attended the scientific sessions It is certain, however, that between fifteen hundred and two thousand attended one or more technical sessions of the association or associated societies Each of the evening sessions at the Greek Theater in Los Angeles was attended by about one thousand persons, about half of whom were registered All the audiences at the Greek Theater were attentive and seemed much interested in the scientific discussions.

The residence distribution of those who registered at the association's offices is shown by the following table

State	Total	State	Total
Arizona	31	New Mexico	5
California	922	Ohio	5
Colorado	9	Oregon	22
Connecticut	4	Pennsylvania	5
District of Columbia	11	Rhode Island	2
Florida	1	Texas	4
Hawaii	10	Utah	21
Idaho	5	Washington	15
Illinois	12	Wisconsin	6
Iowa	5	Canada	8
Kansas	4		
Maryland	1	Foreign Countries	
Massachusetts	13	Australia	1
Michigan	2	England	2
Minnesota	8	Germany	5
Missouri	9	Japan	2
Nebraska	4	Palestine	1
Nevada	2	Russia	1
New Jersey	2		
New York	31		1,193

THE LOCAL COMMITTEE AND REPRESENTATIVES OF SECTIONS

The general local committee for the Pasadena meeting was made up as follows:

P W Merrill, general chairman

H B Babcock, general secretary

L. H Gilmore, executive secretary

D S Mulvin, treasurer

I S Bowen, chairman of the subcommittee on exhibits.

J P Buwalda, chairman of the subcommittee on public lectures.

R. L Daugherty, chairman of the subcommittee on local service

R. A Millikan, chairman of the subcommittee on finance

L C Pauling, chairman of the subcommittee on meeting places

R. O Schad, chairman of the subcommittee on registration

R. W Sorensen, chairman of the subcommittee on excursions

Franklin Thomas, chairman of the subcommittee on entertainment

E C Watson, chairman of the subcommittee on program and publicity

Subcommittee on Finance R. A Millikan, Chairman, W S Adams, A G Arnoll, Max Farrand, P W Merrill, R. O Schad, E C Watson

Subcommittee on Public Lectures. J P Buwalda, Chairman, H D Babcock, Harry H Main, R. A Millikan, L C Pauling

Subcommittee on Program and Publicity E C. Watson, Chairman, A H Joy, Editor of General Program; B M Allen, H D Babcock, E C Barrett, E T Bell, J P Buwalda, Roy E Campbell, R L Daugherty, Wm Dunkerley, H de Forest, M R Harrington, E. R Hedrick, Harry H Main, T H. Morgan, W B Munro, Seeley G Mudd, L C Pauling, G Ross Robertson, A. H Sturtevant, T Wayland Vaughan.

Subcommittee on Excursions R W Sorensen, chairman, B M Allen, E G Anderson, H W. Clapp, Wm. Hertrich, H de Forest, A. L. Klein, W. N Lacey, Harry H. Main, R R Martel, F G Pease, F L. Ransome, Raymond M Selle

Subcommittee on Exhibits· I S Bowen, Chairman; A O Beckmann, L E Bliss, S B Nicholson, Raymond M Selle, R W Sorensen, Chester Stock, A H Sturtevant, R M Sutton, H O Wood

Subcommittee on Local Service. R L. Daugherty, Chairman, J. E Bell, H W Clapp, Wm Dunkerley, Harry H Main, Sinclair Smith, W. R Smythe, L. E. Wear.

Subcommittee on Meeting Places· L C. Pauling, Chairman; S J Bates, H Borsook, B. W Howard, A. H. Joy, R. T Knapp, S S. Mackeown.

Subcommittee on Registration: R. O Schad, Chairman, Harry H. Main, F. H. Seares, H C. van Buskirk.

Subcommittee on Entertainment: Franklin Thomas, Chairman; J W. Du Mond, W. V. Houston, E P Hubble, Morgan Ward

Ladies' Entertainment Committee Mrs. R A Millikan, Chairman; Mrs. Walter S Adams, Mrs Harry Bateman, Mrs. Stuart J Bates, Mrs Leslie E Bliss, Mrs I S Bowen, Mrs John P Buwalda, Mrs Roscoe G Dickenson, Mrs. Jesse Du Mond, Mrs Max Farrand, Mrs George E Hale, Mrs F W. Hinrichs, Jr, Mrs. E. P Hubble, Mrs William N. Lacey, Mrs P W Merrill, Mrs Thomas H. Morgan, Mrs William B Munro, Mrs Linus C Pauling, Mrs Frederick L Ransome, Mrs Robert O Schad, Mrs R W Sorensen, Mrs Chester Stock, Mrs Franklin Thomas, Mrs Richard C Tolman, Mrs Morgan Ward

LOCAL REPRESENTATIVES FOR THE SECTIONS

Section A (Mathematics), E R. Hedrick, University of California at Los Angeles

Section B (Physics), E C Watson, California Institute of Technology

Section C (Chemistry), G Ross Robertson, University of California at Los Angeles

Section D (Astronomy), S B Nicholson, Mount Wilson Observatory

Section E (Geology and Geography), J P Buwalda, California Institute of Technology

Section F (Zoological Sciences), B M Allen, University of California at Los Angeles

Section G (Botanical Sciences), H de Forest, University of Southern California

Section H (Anthropology), M R Harrington, Southwest Museum

Section I (Psychology), S I Franz, University of California at Los Angeles

Section K (Social and Economic Sciences), W B Munro, California Institute of Technology

Section L (Historical and Philological Sciences), W B Munro, California Institute of Technology

Section M (Engineering), R L. Daugherty, California Institute of Technology

Section N (Medical Sciences), Seeley G Mudd, California Institute of Technology

Section O (Agriculture), W. P Kelley, University of California at Riverside

Section Q (Education), W H Hughes, Pasadena, California.

OFFICERS OF THE ASSOCIATION FOR THE CALENDAR YEAR 1931[1]

President, Franz Boas, Columbia University

Retiring President, Thomas Hunt Morgan, California Institute of Technology.

Permanent Secretary, Charles F Roos (1932)

General Secretary, Burton E. Livingston (1932), Johns Hopkins University.

Treasurer, John L. Wirt (1932), Carnegie Institution of Washington.

Secretary of the Council, Charles A. Shull, University of Chicago

Executive Assistant, Sam Woodley

Auditor, A. G McCall, U S. Department of Agriculture

Director of the A A A S Press Service, Austin H Clark, U S National Museum

Director of Exhibition, H S Kimberly

Members of the Executive Committee of the Council

J McKeen Cattell (1934), *Chairman*, Franz Boas (1931), *President of the Association*, Karl T Compton (1933), Massachusetts Institute of Technology, David R Curtiss (1931), Northwestern University, Joel H Hildebrand (1931), University of California, Vernon Kellogg (1932), National Research Council, Burton E Livingston (1932), *General Secretary*, Johns Hopkins University, Robert A Millikan (1933), California Institute of Technology, Charles F Roos (1932), *Permanent Secretary*, Henry B Ward (1934), University of Illinois, Edwin B Wilson (1932), Harvard School of Public Health

The general local committee and its subcommittees have rendered invaluable service in working out plans and precedents for this first summer meeting of the new series and in caring for the innumerable details of arrangements that constitute the preliminary preparations for a great scientific meeting. As general chairman of the local committees, Dr Paul W. Merrill, of the Mount Wilson Observatory, has given freely of his time and energy He was ably assisted by Mr Harold D Babcock as secretary of the local committee, in coordinating and carrying out the work of the several subcommittees Professor E. C Watson, of the California Institute of Technology, devoted almost all of four months of his time as chairman of a General Program Committee whose object has been to synchronize, coordinate and enlarge the programs of the various societies and sections meeting with the association at Pasadena As a result of the efforts of Professor Watson and his program committee many interesting symposia and joint sessions have developed The council voted to ask the permanent secretary to find some one to do the same important service for the New Orleans meeting. The chairman of every subcommittee has worked faithfully and well and to all of them—Dr Robert A. Millikan, Dr I S Bowen, Dr Linus C. Pauling, Professor Franklin Thomas, Professor R L. Daugherty and Mr R. O Schad, and all their committeemen—are due the grateful and lasting thanks of the association.

The Pacific Division of the association, desiring to cooperate in every way to make this first summer meeting really national in character, withdrew the meeting which it regularly holds in June, and its officers and executive committee have given valuable assistance in planning and arranging the program. Dr. J. Murray Luck, secretary of the Pacific Division, made most of the program arrangements with the associated societies, and prepared much of that material for both the preliminary and general program, as well as cooperated in many other ways

---

[1] The number in parenthesis denotes the calendar year at the end of which the member's term of office is to expire.

Mr A H Joy, of the Mount Wilson Observatory, in the absence of a permanent editor, took up the responsibility of the editing of the general program at a comparatively late date, and very generously gave several weeks of his time to this task

GENERAL RECEPTION AND ENTERTAINMENT

Through the courtesy of the director and the trustees of the Huntington Library and Art Gallery a reception in the gardens of the Huntington estate officially opened the meeting on the afternoon of Monday, June 15 Dr Max Farrand, director of research at the library, presided at the reception and welcomed the association in behalf of the host institutions The chair was then taken by Dr Thomas Hunt Morgan, the retiring president of the association, who introduced Dr Franz Boas, the new president Following a short response by Dr Boas, the gardens, library and art galleries were opened to the members Refreshments were served continuously in the palm garden amid the soft melodies of two harps

The grounds of the Huntington estate comprise a little over two hundred acres and are largely devoted to a beautifully landscaped garden Luxuriant tree ferns, cycads and palms give it a subtropical effect of unusual charm Other special features are the cactus collections containing over 18,000 specimens and a Japanese garden

Tea was served at the Athenaeum on the afternoons of Tuesday, Wednesday, Thursday and Friday, from 4 00 to 5 00 P M The members of the ladies' entertainment committee served admirably as hostesses at these delightful receptions

EXCURSIONS

Interesting excursions were arranged for every afternoon to nearby places of special interest under the leadership of competent guides On Tuesday afternoon four or five hundred members availed themselves of an opportunity to visit the Busch Gardens, which are not regularly open to visitors A Spanish orchestra and singer entertained with Spanish melodies and songs during the luncheon served on the grounds

About three hundred members took advantage of the Wednesday afternoon tour of Hollywood, Beverly Hills, the Beaches, Fox Film Studios and the University of California This tour was complimentary to the visiting members by the Los Angeles Chamber of Commerce An excellent box lunch was furnished delegates to eat on the bus.

The excursion to Mount Wilson on Wednesday afternoon for members of Section D and the Astronomical Society of the Pacific was taken advantage of by about 125 members who were given an opportunity to see the instruments of the observatory in operation

On Thursday afternoon many members took the electric cars for Mount Lowe and lunched on top of the mountain About twenty or thirty of these walked six miles over a mountain trail to Mount Wilson for dinner at six o'clock

There was also a second group of eighteen excursions by arrangements These included trips to the Huntington Library and Art Gallery, to Dr Michelson's light equipment at Irving Ranch, to the San Gabriel Mission, founded in 1771, to the Chaparral and Conifer Forest of the mountains, to the Colorado Desert, and so forth

A gasoline launch, the *Anton Dohm*, built for dredging and trawling operations, was graciously provided by the University of Southern California for those biologists who wished to take advantage of a marine dredging trip

The fact that there was sufficient demand to hold every one except one (beginning at 3 00 A M) of the twenty-three excursions announced in the general program is a sure indication that Professor Sorensen and his excursion committee knew exactly what association delegates wished to see.

MEETINGS OF THE COUNCIL

The council of the association held three meetings in Pasadena The first session was called to order at 9 04 A M, Tuesday morning, with President Boas presiding The following items of business were transacted

(1) The executive committee reported to the council that the Society of Rheology and the Acoustical Society of America were affiliated with the association at the April meeting of the executive committee of the council These societies have one representative each on the council

(2) The American College Personnel Association and the American College of Dentists were associated with the association

(3) The executive committee reported to the council that the Northwest Scientific Association was affiliated with the American Association for the Advancement of Science as an academy of science at the April meeting of the executive committee No financial arrangements were made with the Northwest Scientific Association

(4) The council voted approval of the application of the Midwestern Psychological Association for affiliation The membership of this association is

322, of whom 63 are fellows of the American Association, and 61 members

(5) The council voted that the general programs of the American Association for the Advancement of Science be edited by the permanent secretary's office

(6) After extensive discussion of the problems connected with the publication of the general programs, the council voted that eight-point type should be used wherever it seemed desirable, in printing the general program of the New Orleans meeting

(7) The council voted approval of the application of the Union of Biological Societies for a grant of $400 of the treasurer's funds for use in obtaining additional subscriptions for *Biological Abstracts*

(8) The council adjourned at 9 56 A M, to meet June 17 at 9 00 A M

SECOND SESSION

Wednesday, June 17, 1931

(1) The council was called to order at 9 03 A M, with President Boas in the chair

(2) The minutes of the first session of the council on June 16 were read and approved

(3) The council approved the recommendation of the committee on foreign guests of the association that the 1933 meeting in connection with the Chicago World's Fair centennial celebration be held the last week in June

(4) The council confirmed the action of the executive committee in selecting Syracuse for the 1932 summer meeting, and Atlantic City for the 1932 winter meeting The date of the Syracuse meeting was fixed as the week beginning June 20, 1932

(5) The council voted that it looks with favor upon holding the winter meeting of 1933 at Boston, the summer meeting of 1934 at San Francisco and the winter meeting of 1934 at Rochester

(6) The council voted that the permanent secretary be instructed to submit annually a list of proposed meeting places, including those mentioned in the previous section of the minutes, to the secretaries of all affiliated societies and to all members of the council, for comment and suggestion to serve as a basis for selection of meeting places.

(7) The permanent secretary presented to the council a report of the local committee on finance for the Cleveland meeting This was followed by a full discussion of the methods of financing the meetings of the association, after which the council voted that the arrangements for financing the New Orleans meeting be referred to the executive committee, with power to make such arrangements as they might deem wise.

(8) The council adjourned at 9.50 A M, to meet at 9:00 A.M., June 18

THIRD SESSION

Thursday, June 18, 1931

(1) The council was called to order at 9 05 A M, with President Boas presiding

(2) The minutes of the meeting on June 17 were read, amended and approved as amended

(3) On recommendation of the executive committee, the council voted that the memorandum of the Societa Generale Italiana Di Elettricita be referred to the American Physical Society, and that of the International Congress of Prehistoric Archeology be referred to the American Anthropological Association

(4) On recommendation of the executive committee, the council voted that a committee, consisting of Dr J McK Cattell and Dr Burton E Livingston, be asked to confer with Mr Austin H Clark concerning the directorship of the Press Service of the association

(5) The council voted that a preregistration plan be tried for the New Orleans meeting in December, 1931, if arrangements for financing the plan could be made

(6) A resolution expressing appreciation of the association to all committees and institutions whose cooperation contributed to the success of the Pasadena meeting was adopted

(7) An informal discussion of plans for unifying and coordinating the meetings of sections and affiliated societies was held, and it was the consensus of opinion that the permanent secretary should consult with the secretaries of such societies, and take whatever steps seemed feasible to secure a unification of programs at the meetings

(8) Dr William B Reid appeared before the council as the representative of Chancellor Charles W Flint, of Syracuse University, and discussed the plans for the summer meeting at Syracuse in 1932

(9) The council adjourned at 9 52 A M, to meet at New Orleans in December, 1931

THE SCIENTIFIC EXHIBITION

Many interesting scientific and research exhibits were opened to the general public An actual demonstration of the utilization of light by the green plant to form oxygen and starch was shown Since the pigments chlorophyll and the carotinoids of the leaf are the agents active in this light absorption, they were exhibited and their light-absorbing ability demonstrated

On two different nights Mount Wilson Observatory was thrown open to the delegates and Dr Hubble and others explained the operation of the 100-inch telescope and other instruments at the observatory Delegates were allowed to use the 100-inch telescope to see distant nebulae. An exhibit of photographs and diagrams illustrated and explained the methods used in determining the distance and distribution of nebulae, and showed the results which have been obtained in such explorations of space.

The California Institute of Technology and the Southwest Museum cooperated in exhibiting remains found in Gypsum Cave in Nevada Materials of the ground sloth were especially noteworthy because of their remarkable preservation The collection included skeletal remains with dried tendonal strands adhering to the external surfaces of the bones, claws with horny sheaths, hair, small bits of hide and dung The circumstances of the finding of these remains and remains of man in Gypsum Cave are such as to suggest that man was contemporary with the sloth

The Los Angeles Museum displayed some of the more striking fossil material removed from the Pleistocene asphalt deposits of the Rancho La Brea. This museum also exhibited some of the specimens found at Gila Valley, Arizona, in 1930–31 These latter specimens were obtained from a thirty-acre site one mile east of Casa Grande National Monument, upon which the expedition located and excavated three crematory areas, fifty houses, offertory area and several large trash mounds The cremation-pit burials yielded a wealth of pottery, carved bone, stone and shell artifacts, indicating the existence of an early culture Most interesting were the badly calcined bases of mirrors, the reflecting surfaces of which were mosaics of iron pyrite crystal fragments

One of the most interesting of all the exhibits was a representative collection of living reptiles from the Southwestern states The American Society of Ichthyologists and Herpetologists was responsible for this excellent exhibit

Numerous other less spectacular exhibits were opened to the public Special mention should be made of the exhibit of the Scripps Institution of Oceanography of the University of California, showing subsurface movements of the waters in the Gulf of Alaska, a cabinet of vials containing the relative amounts of the different more important constituents of sea water, and among other things an exhibit of apparatus used in the study of oxygen consumption of certain marine fishes Those responsible for this exhibit were Doctors George F McEwen, E. G Moberg, Burt Richardson, W E Allen, N A Wells and F B Sumner

Dr R A. Millikan exhibited electroscopes used in various phases of cosmic ray investigations Dr Sinclair Smith, of the Mount Wilson Observatory, showed some extremely sensitive energy measuring devices developed for the measurement of radiation from astronomical bodies. Dr. Hawley Cartwright demonstrated some extremely sensitive thermocouples Maps and charts showing the various aspects of the Colorado River development, prepared with the aid of the Metropolitan Water District of Los Angeles, were also exhibited

The association maintains a committee on the Science Research Exhibition, of which Dr. F C. Brown, of the Museum of Science and Industry, New York City, is chairman, and Mr Owen Cattell, of The Science Press, Grand Central Terminal, New York City, is secretary. This committee asked Dr I S Bowen, of the California Institute of Technology, to act for it in securing and arranging exhibits for the Pasadena meeting The association is grateful to Dr Bowen for giving so much of his time in securing and arranging this large, excellent scientific exhibition

GENERAL SESSIONS

The general sessions encourage the cultivation of the broader aspects of scientific thought and the interchange of ideas between the several groups of men and women of science At Pasadena they were freely open to all who wished to attend, to the general public as well as to scientific workers, but seats were reserved for those who had registered

The association was unusually fortunate this year in the arrangement of its general sessions, a very important task to which Dr J P Buwalda, of the California Institute of Technology, and his committee on public addresses gave much attention. Dr. Robert A. Millikan was an important member of this committee and as a member of the executive committee of the association acted for it in issuing invitations to association speakers Men of the highest scientific eminence presented these addresses in non-technical language in such a way that they would be of maximum benefit to laymen and scientists in other fields of work The following brief reports of these sessions are based on the general program and on notes made by the permanent secretary

Dr Franz Boas, the president of the association, gave the first of the evening lectures on Monday evening at the Greek Theater in Los Angeles. Dr. Thomas Hunt Morgan, the retiring president of the association, introduced Dr Boas, who chose the subject "Race and Progress." Declaring his firm adherence to the theory that infusion of new blood in a race stimulates progress, Dr Boas said. "The high nobility of all parts of Europe is of mixed origin, but it would be difficult to show that degeneracy has resulted from such interbreeding" He declared that America's melting pot is performing a great work for Caucasian civilization "What is happening in America now is the repetition on a larger scale and in a shorter space of time of what happened in Europe during the centuries when the peoples of northern Europe were not firmly attached to the soil" Dr. Boas' complete address may be found in SCIENCE for July 3, 1931.

On Tuesday evening Dr. H D Arnold, director of the Bell Telephone Laboratories, gave the second of the series of evening lectures at the Greek Theater Dr. Arnold's address was an illustrated one on the subject, "Science Listens" Speech waves danced across a projection screen while the audience heard their counterparts through loud speakers One of the most dramatic of Dr Arnold's demonstrations was that in which the audience heard electrons in a solid iron bar turning over under the influence of a magnetic force Dr Arnold gave a companion demonstration in which he made it possible for the audience to hear noise-currents set up inside a wire When the wire was heated the noise increased as the dance of the electrons was speeded up Under the chill of liquid air the electrons slowed up and their noise was almost inaudible This effect known as the Johnson effect is of great importance as it fixes a lower limit of sound currents which can be amplified without excessive noise interference.

Dr Arthur L Day, director of the Geophysical Laboratory of the Carnegie Institution, delivered the third of the lectures at the Greek Theater on the subject, "The Present Status of Seismology" According to Dr Day, earthquakes are not chance phenomena and should not be regarded superstitiously They are the results of definite causes which are gradually being recognized and understood Although earthquakes occur everywhere over the earth's surface, they occur more frequently in "young areas" in which mountains are still growing Dr Day praised geological researches which are being done and said · "One of the recent discoveries is that the earth is made up of concentric shells These shells are tens of hundreds of miles thick, and transmit earthquake waves differently and at different speeds" Nearly everything so far known about the earth's deep interior has been learned from studies of earthquake waves

In the fourth of the evening lectures Dr Charles A Beard, noted historian, spoke on the subject, "Scientists and History." According to Dr Beard, scientists' ideas, equipment and personality are the product of history. "The scientist himself is a product of history—congealed, so to speak." A single scientist may be indifferent to his environment, may refuse to consider the relation of his special work to society, but consciously or not he is influenced in his interests and his thinking by the society and climate of opinion in which he labors. Dr. Beard challenged scientists to remedy the present economic situation He said. "Science has demonstrated that there is for practical purposes no limit to the possibilities of goods production, but millions are hungry What has science to say? Is it possible that mankind has conquered the physical universe but cannot make wise and efficient use of its discoveries?"

Dr Edward Hubble, of the Mount Wilson Observatory, and one of the world's foremost explorers of outer space, gave the fifth and concluding lecture at the Greek Theater on the subject, "The Realm of Nebulae" He declared that finding out what the physical universe is made of is one of the ultimate problems of science and modern astrophysics is leading nearer and nearer to a solution of the problem In former days the available sample of the universe consisted first of a portion of the earth's surface, then of the sun and its family of planets, and later of a portion of the stellar system The observable region at present is defined with the 100-inch reflector and hence that telescope has been used for a first survey of the region as a whole. Two very general characteristics have been determined In the first place, as far as the telescope can reach, the distribution of the nebulae is approximately uniform. "The nebulae are scattered more or less at random at intervals averaging something over 1,500,000 light years" The second general characteristic is a strange relation between distance and certain displacements in the spectra of nebulae (red-shifts) which are sometimes interpreted as indicating velocities away from the earth It is as though the universe were expanding from the earth as a center and the outer regions were expanding the more rapidly according to their distances "The authorities are not yet agreed as to whether the red-shifts represent actual motion (as they clearly do on a very small scale for the stars in our own system) or some hitherto unrecognized effect whether physical or arising from the structure of space itself"

THE PRESS SERVICE

(*By Austin H. Clark, director of the Press Service*)

Thanks to the promptness with which the members of the association responded to the request for copies of the papers which they were to deliver, and to the excellent way in which the papers and abstracts were prepared, the amount of press notice given the Pasadena meeting was considerably in excess of what had been anticipated

One copy of each of the papers was retained in Washington and the other was sent to Pasadena so that press representatives in both cities were able to use the same material at the same time.

Professor E. C. Watson, of the California Institute of Technology, was responsible for all press arrangements and contacts at Pasadena, and the excellent and extensive notice accorded the meeting by the press was in no small measure the result of his conscientious and efficient work

The association is again under deep obligation to Science Service for cordial and most unselfish cooperation The staff of Science Service did everything possible to insure the success of the meeting from the press standpoint, even going so far as to volunteer assistance which it would have been quite unreasonable to have requested of them

SCIENTIFIC SESSIONS

SECTION A (MATHEMATICS)

(*Report from A D Michal*)

Section A held two sessions for the reading of three invited papers Attendance at the sessions averaged about fifty Chairman E R Hedrick prefaced the reading of the papers in the morning session by calling the attention of those present to a tentative list of foreign mathematicians to be invited to give lectures at the Chicago, 1933, meeting of the A A A S

Professor Curtiss gave an indication of various diophantine problems treated by him in a paper published in the *Bulletin* of the American Mathematical Society in 1929 He pointed out some applications connected with the conformal mapping of a plane on a triangle and the covering of a plane with regular polygons and then went on to illustrate the method of exhaustions Professor Curtiss commented on some unsolved problems and in particular on an asymptotic formula for the number of integer solutions of an algebraic equation with integer coefficients subject to auxiliary conditions

Professor O D Kellogg, of Harvard University, gave the second paper of the morning session He prefaced the main part of his talk with a historical introduction to the Dirichlet problem He pointed out that it was not until 1913 that Zaremba showed that the Dirichlet problem with continuous boundary values is not possible for every region After introducing the method of sequences, a generalization of Poincaré's balayage method, Professor Kellogg went on with the enunciation of an unsolved uniqueness problem, the solution of which is equivalent to showing that every bounded set of points of positive capacity contains a regular point This point set theorem holds good in two dimensions and the question is whether it continues to hold in three dimensions Dr Kellogg discussed the capacities of Cantor sets and in conclusion raised the question whether the positive capacity of a point set is a topological property On Tuesday afternoon, J V Uspensky, of Stanford University, spoke on integration in finite form He gave an ordered account of some classical researches of Abel and Liouville on elliptic integrals. Professor Uspensky discussed some of the arithmetic problems that arise in connection with Weierstrass' practical solution of the problem of finite integration by throwing it into a transcendental form with elliptic functions He spoke of the periodicity of triads of integers and referred to Tchebysheff's criterion of periodicity (1860) In conclusion Professor Uspensky mentioned Zolotareff's remarkable criterion involving algebraic numbers (1874) and pointed out that Zolotareff devised his theory of ideal numbers as a by-product

SECTION B (PHYSICS) AND RELATED ORGANIZATIONS

(*Report from Leo Loeb, J A Van den Akker and Floyd D Young*)

Section B met with its associated societies, the American Physical Society and the American Meteorological Society Three very interesting symposia were arranged for the joint meeting with the American Physical Society These proved to be the best attended and most valuable part of the meetings The first symposium, on "The Physics of Crystals," was opened by Dr F Zwicky, who presented a paper on "The Secondary Structure of Crystals" Other papers were presented by Dr P W Bridgman, Dr C J Davisson and Dr Alexander Goetz Dr Zwicky showed that the reasons which make for a secondary structure in crystals are of a very general nature, and that they even may provide a solution of the very fundamental problem why do crystals exist (in contradistinction to amorphous solids, liquids and gases)? Dr Bridgman reported he has found in his work with metal single crystals that in many cases the electric anisotropy in a crystal is not the same as the crystallographic anisotropy The work of Davisson and Germer, G P Thomson and others has shown quite definitely that electron beams possess a wave nature Electron beams, like x-rays, may now be used for the study of crystals, and, in certain cases, the method of electron diffraction may prove to be superior to that of x-rays The surface conditions of crystals may be studied quite satisfactorily by electron diffraction, and, where electron beams of effective short wave-length are required, it is not necessary to go to high potentials Dr Davisson concluded his paper with a description of recent work carried out in his laboratory on electron diffraction from tungsten. Dr. Goetz and his associates have been searching in the past few years for evidence for a substructure in metal crystals New methods for etching crystal surfaces were described, and very fine reproductions of microphotographs of etched surfaces were shown. It is now possible to etch with controlled potentials and it is thus possible to locate and measure the potential hills and valleys normal to the etched crystal surface The magnitudes of the potentials are functions of the degree of impurity in the bismuth single crystals It was shown that the bismuth single crystal becomes *paramagnetic* in the direction of the principal axis under certain conditions of low temperature and composition

Dr W F G Swann, who presided at these meetings, opened the second symposium, on "The Present Status of the Problem of Nuclear Structure," with a talk on a possible mode of solution of the general problem Dr Swann reviewed the difficulties encountered by the old electromagnetic theory in explaining the close packing of electric charges in the nucleus, and emphasized that the most significant relation which we should bear in mind is the simple one which states the equivalence of mass and energy Dr Swann showed that it may prove possible to explain the upward rise in Aston's mass defect curve by the coming together of electrons and protons Professor R H Fowler, of Cambridge, England, reviewed the experimental knowledge of the nucleus and some of the theoretical work Alpha particles apparently come from definite energy levels in the nucleus, since a study of the ranges of alpha particles in air reveals the important fact that only discrete ranges exist On the other hand, there appears to be no evidence for the existence of electronic states in the nucleus, while one can find connections between the gamma-ray energy levels and the stationary states of alpha particles In Bothe's experiment, which was mentioned, alpha particles were shot on to a very thin foil of aluminum, and it was found that the bombardment caused the ejection of H-rays on the emergent side of the foil The absorption of an alpha particle accompanied by the ejection of a proton from a nucleus would mean a change in atomic weight of three, and thus it may prove possible to relate the isotopes of two elements by this type of transformation Dr W Pauli, of Zurich, Switzerland, pointed out that the two chief difficulties in nuclear theory are the breakdown of the alternation rule and the existence of a continuous beta-ray spectrum A number of elements such as nitrogen do not obey this rule Dr Pauli attempted to overcome this difficulty and at the same time provide for the possibility of a continuous beta-ray spectrum by the introduction of a third kind of particle called the neutron If the neutron can be assumed to have a spin angular momentum of one half quantum, and a mass less than one one-hundredth the mass of a proton, all known experimental results can be explained Dr S A Goudsmit reviewed recent successes and failures of theories of hyperfine structure The theory met with success at first, but recently cases have been met where it fails entirely to explain the fine structure. While the theory of hyperfine structure is at present in an unsettled state, there can be little doubt that future investigations in hyperfine structure will tell us a great deal about the nucleus Professor W M Latimer applied the methods of the chemist to the problem of the nucleus He has constructed very ingenious models (which resemble crystal models) of the nuclei of the lighter elements While the modern tendency in atomic structure investigation is to avoid models or physical pictures, it was felt by the majority of those who attended this symposium that a model of the sort which Professor Latimer proposes for the nucleus may aid materially in the development of the proper kind of analysis

The third symposium, on "The Production of High Energy Electrical Particles," was opened by Dr W D Coolidge, of the General Electric Company, who discussed a number of practical details concerning x-ray tubes From a practical point of view thorough degassing of the target and all metal parts is necessary, and it has been found that, in general, nitrogen is the most troublesome gas Cold cathode effects limit the voltage at which a tube can be operated, and field currents to the glass walls of a tube cause fluorescence where, microscopic examination shows, tiny canals are cut into the surface of the glass Thorough degassing reduces this destructive effect, while the use of hollow anodes cuts down the number of reflected electrons and offers x-ray protection. Dr Coolidge described the new 900 kv x-ray tube which is in use at the Memorial Hospital, a new type of high tension induction coil for the operation of high voltage tubes, a new cascade transformer, and an oil immersion x-ray outfit Dr M A Tuve, of the Carnegie Institution, presented a paper in which he reviewed the work which he and his associates have done with oil-immersed x-ray tubes and Tesla coils It will be recalled that Dr Tuve and his associates, L R Hafstad and O Dahl, received this year's association prize for their very fine work in this field Using the J J Thomson parabola method, the velocities of the electrical particles produced in the high voltage vacuum tubes have been checked, and the x-rays have been compared with gamma-rays. By means of a Geiger-Mueller tube and absorbing screens, it has been possible to show that the absorption coefficient of the x-rays was about the same as that of the gamma-rays from radium More recently a Wilson cloud-expansion chamber has been utilized in order that experiments on nuclear disintegration may be performed The third paper in this symposium was presented by Professor E O Lawrence. The two methods for the production of high velocity canal rays developed by Professor Lawrence and his associates, one for the production of high velocity heavy ions and the other for light ions, both involve resonance between the electric particle along its path and a high frequency oscillation Mercury ions possessing 1,050,000 electron volts equivalent energy can be produced by only 35,000 volts applied at a frequency of 8,535 kilocycles Electric and magnetic deflection tests have confirmed the velocities These methods are particularly valuable because they can be used by investigators whose funds for research are "modest," and because relatively little space is necessary Dr C C Lauritsen spoke on "High Voltage X-Ray Tubes with Short Electron Path" The essential features of this type of tube are its short electron path (about 4 cm), its inner electrode which runs along practically the whole length of the tube, and its cylindrical sheaths which are coaxial with the inner electrode and are used to protect the glass walls of the tube from electron bombardment The more recent tubes are equipped with filaments in both electrodes, a target in the upper electrode, and a hole covered with tin foil in the lower (external) electrode, in order that cathode rays may be brought out of the tube These tubes are normally operated at 600 to 700 kv The last paper in this symposium, by Dr A Brasch and Dr F Lange, was read by Dr Alexander Goetz Due to low funds, these men could not build high tension equipment on a large scale, so they climbed Monte Generose, where they established a small laboratory on a saddle between two peaks There they harnessed lightning and drew eighteen meter sparks Preliminary experiments gave them valuable clues to the solution of the problem of insulation Breakdown seems to be due to gliding of charges on the surfaces of dielectrics When the time of discharge in a tube is very short, of the order of 10^{-4} sec, the insulation need not be perfect, and the vacuum in a tube need not be particularly good. The tube which withstood the exceedingly short shocks most satisfactorily was built out of rings of paper, aluminum and rubber, the rings were not cemented together, the length of the tube was only 84 cm, and the tube was immersed in oil (oil of good quality was not necessary) The high voltage shocks were furnished by an ingenious system of condensers which were charged in parallel, then switched into series connection, producing voltages up to 2400 kv (A new surge generator under construction will produce voltages up to seven million) The source of electrons in their vacuum tube was not a filament, but a short porcelain tube of small bore, while protons were generated in a very fine jet of water which was forced into the tube by means of a steam boiler The half-value thickness of the rays from the tube was found to be 8 mm in lead, while protons generated in a tube at 900 kv would penetrate 0.008 mm aluminum foil

The last symposium was appropriately followed by one arranged by Section N (Medical Sciences), on "High Voltage X-Ray Tubes and Their Medical and Biological Possibilities," an account of which is given in the report for Section N A number of the members of the Physical Society attended the Wednesday morning session of the Astronomical Society of the Pacific in cooperation with Section D, while some physicists attended the symposium arranged by Section E on "Major Problems of Modern Oceanographic Research."

On Friday evening, June 19, a joint dinner was held at the Huntington Hotel for physicists, astronomers and mathematicians About one hundred guests attended and adjourned thereafter to attend the lecture by Dr Hubble, an astronomer of the Mount Wilson Observatory

The Pasadena meeting of the American Physical Society was unquestionably the most successful meeting ever held on the Pacific Coast and in the opinion of several prominent physicists was the most successful ever held in America. Attendance during the symposia was well above two hundred and the attendance at the regular meetings was above a hundred

The 1931 meeting of the Pacific Coast Branch of the American Meteorological Society opened on the morning of June 17, with Major Edward H. Bowie, vice-president of the society, presiding. From the standpoint of attendance and the character of the papers presented the meeting was the most successful ever held by the Pacific Coast Branch The character of air drainage and its influence on local temperatures at points with varying topographical surroundings was discussed by Mr. E. S. Ellison. He pointed out that "frost pockets" of relatively small area are colder than larger ones and gave advice on considerations to be kept in mind in locating an orchard to minimize the frost hazard. Dr Seth B Nicholson, in an address on the relation of weather to variations in solar activity, pointed out that while sun-spot cycles are fairly well understood, no method of predicting them exactly has yet been found. Curves have been developed by mathematical analysis which have coincided with past data almost exactly, yet failed utterly when projected into the future.

Mr. John L. Bacon, in a paper on the Boulder Canyon-Colorado River development, said that the enormous amount of concrete to be used in the construction of the Hoover Dam introduces problems in cooling never before encountered. Chemical changes which take place during the hardening of concrete are accompanied by the release of heat. Owing to the unusual thickness of the dam, averaging 500 feet, approximately one hundred years would be required for normal cooling and contracting so that the contraction joints could be filled and the dam made monolithic and water tight. In order to take care of this problem the cooling of the dam will be hastened by the installation of a mechanical cooling plant, large enough to care for the needs of a city of approximately 200,000 people, and the circularization of brine through a network of pipes placed permanently in the concrete

Dr Carl L. Alsberg largely attributed the tendency toward alternating large and small wheat crops to weather conditions at the time the buds are formed Mr Floyd D Young gave the results of studies to determine the effectiveness of wind-breaks in protecting orchards from wind damage Mechanical injury to fruit is caused by strong winds, whatever their direction or moisture content, but foliage burn takes place only when the relative humidity is ten per cent. or less

Dr Charles C Conroy gave an account of the methods he has used to extend the annual rainfall record at Los Angeles through the period from 1850 to 1877 Recent investigations on the structure of the stratosphere have caused a radical change of view Observations of meteors, the spectra of the aurora polaris observed in layers of the atmosphere in the shadow of the earth and in sunlight, respectively, and observations of the passage of sound waves through the stratosphere indicate an increasing temperature beginning at a height between 30 and 40 kilometers, no change in composition up to a height of at least 150 kilometers, no hydrogen at any height, a slowly decreasing amount of oxygen at heights of several hundred kilometers, and probably a small amount of helium, water vapor and neon at very great heights, with nitrogen predominating at all heights

SECTION C (CHEMISTRY) AND RELATED ORGANIZATIONS

(*Report from Mark Walker and Linus Pauling*)

Section C met with its affiliated society, the American Chemical Society, Pacific Intersectional Division, for the reading of sixty-one papers, including those given at joint symposia with Sections B, E and F and Sections F and G. All meetings were well attended and discussion was lively. In the symposium, "Quantum Mechanics and the Chemical Bond," the scientists who have contributed most to the subject were present. Dr W Heitler, of Göttingen, showed that the quantum mechanics leads to the result that in general the normal electronic state of a molecule is not accurately represented by a single electronic formula of the Lewis type, but corresponds instead to a combination of two or more Often one of these Lewis formulas alone is a very good approximation to the normal state Professors Slater and Pauling discussed the latest developments in the theory of directed valence bonds. The theoretical treatment for a simplified model of the water molecule was carried through by Professor Slater, who showed that the stable configuration has an angle of about 90° between the two valence bonds Professor Pauling gave a simple method for predicting the angles expected between valence bonds in complex ions and molecules, leading to a theory of the tetrahedral carbon atom and of square, octahedral and prismatic complexes of the transition elements A number of chemists and physicists, including Professors N V Sidgwick, W Pauli, Frenckel, S A Goudsmit, and E H Kennard, participated in the discussion

In the symposium on "Reaction Mechanism," Professor W C Bray gave an interesting review of the large amount of work which has been done on oxygen reactions, pointing out the surprising action of certain reducing agents in being rapidly oxidized by oxygen of the air only when some other oxidizing agent is also present This phenomenon was discovered and carefully investigated seventy-five years ago, despite continued investigation it has not yet been given a satisfactory explanation A recent careful study of such an induced oxidation was then reported by Dr J B Ramsey Papers on other phases of the symposium subject were presented by Professors D M Yost and H C Ramsperger

The symposium on "Photosynthesis and photochemistry," with Sections F and G, was opened by the introductory reviews of Dr H H Strain and Dr J H. C Smith. Many new experimental results regarding photosynthetic processes of purple bacteria were reported by Dr C B Van Niel, Dr F M Muller, and Dr Hans Gaffron, and their suggested interpretations were keenly discussed Dr F S Brackett reported results obtained by a new and accurate quantitative method of measuring phototropism The photochemical papers presented in the afternoon session covered a wide field and provoked much interest and general discussion

The Friday morning session devoted to unrelated papers on unrelated subjects was perhaps of the greatest interest to the non-specialist attendants Papers were given by J B Ramsey, J B Watson, Adolf Kunz, J R Lewis, F Seegmiller, G R. Robertson and others.

SECTION D (ASTRONOMY)

(*Report from Philip Fox*)

The astronomical activities may be divided into three classes. The sessions of invited papers attended jointly by Sections B and D and affiliated societies, the usual program of volunteer papers, and inspections of exhibits, observatories and other installations

The first of the joint sessions, a symposium on "The Present Status of the Problem of Nuclear Structure," is reported under Section B The second dealt with some large aspects of astronomy in papers on "The Internal Structure of Stars," by R H Fowler, "Composite Polytropic Gas Spheres," by H N. Russell, "Space Absorption," by F H Seares, "Relativistic Thermodynamics and Problem of Entropy of the Universe as a Whole," by R C Tolman, and the "Distribution of Extra-Galactic Nebulae," by Edwin Hubble These papers emphasized forcibly the changing nature of concepts of the astronomer He sets up models to satisfy the observed phenomena of stellar radiation, the transition through spectral types and at the same time, a comprehensive model which provides an expanding universe which will not "run down" In the paper on "The Contour of Emission Bands in the Spectra of Novae and Wolf-Rayet Stars," Beals finds good agreement between observed contours and theoretical curves calculated on the basis of continuous emission from the surfaces of the stars Seares' investigations of star clusters, extra-galactic nebulae, and obscuring clouds indicate extensive absorption in the Milky Way and high transparency elsewhere The absorption coefficient has large local variations, probably dependent on both direction and distance from the sun Current mean values of the coefficient lead to an improbable space density of stars except in the direction of the center of the system Plaskett and Pearce have dealt with the motions of diffuse gaseous matter in the galaxy in two ways Using the radial velocities of the diffuse matter indicated by the calcium H and K lines in the spectra of 313 stars of O and B types, they find solar motion identical with that from the naked-eye stars and the direction of the galactic center to be in longitude 331° Pearce, in discussing the "Remarkable Stellar System HD 698," finds it of extraordinary mass, the components being respectively 134 and 50 times the sun's mass Further, he finds the interstellar K line in the primary, though its spectrum is B9 This is the first star with spectrum later than B5, in which this line has been observed One may conclude that this interstellar line is present in all spectral types, requiring only that the star be sufficiently remote for the requisite absorption and if stellar calcium be present, that there be high stellar velocity to resolve the fixed calcium line Hubble's paper, based on long exposure photographs well scattered and aggregating about two per cent. of the sky, indicated random distribution with a few definite nebular clusters. Carpenter, who is conducting a somewhat similar survey, reported on "A Cluster of Extra-Galactic Nebulae in Cancer" He detected about sixty members the distance was calculated at 40,000,000 light years. Hubble, who found it independently, noted 150 members, with distance about thirty per cent smaller From the uniformity of structure shown by the distribution of nebulae in seven clusters of nebulae, Carpenter concludes that they are built on a general cosmic plan In the field of stellar spectroscopy Harper compared the Victoria radial velocities with other extensive series The negative value of difference may be ascribed to difference in the systems of wavelengths employed or perhaps in part to a possible small error in curvature correction

Nicholson, van Maanen and Willis outlined a method for determining the mass of Neptune's satellite, comparing the object with Mars, the Moon, the satellites of Jupiter and Titan The masses of those objects and their sizes are known, their magnitudes at Neptune's distance easily found, their albedoes probably bracket that of Neptune's satellite and therefore an approximation to its mass is ascertainable

Lampland has continued his fine series of photographic observations of Pluto The comparison of the 1930–31 observations with the orbit of Bower and Whipple shows excellent agreement The final paper to be noted is that of Bower on the orbit and mass of Pluto The orbit includes the separate actions of the four major planets. As noted above, it fits available observations closely. A final correction may be made if a possible prediscovery position of 1903 becomes available The mass of Pluto might be determined from its gravitational action on Uranus and Neptune, from its magnitude with assumption of albedo, from diameter and assumed density All lead to small values, ranging from eleven times that of the earth to not greater than that of the earth The smaller figure seems more likely

SECTION E (GEOLOGY AND GEOGRAPHY) AND RELATED ORGANIZATIONS

(*Reports from J P Buwalda, C H Danforth, and Perry Byerly*)

On Wednesday morning Section E held a joint symposium with Sections B, C and F on "Major Problems of Modern Oceanographic Research" with Dr T Wayland Vaughan, Scripps Institution of Oceanography, Dr Thomas G Thompson, University of Washington, E. G. Moberg, Scripps Institution of Oceanography, P S Galtsoff, U S Bureau of Fisheries, Washington, D C, and Dr W H. Twenhofel, University of Wisconsin, as the speakers.

On Thursday morning Section E joined with the

Seismological Society of America and Section M (Engineering) in a Seismology-Engineering Symposium, an account of which is given in the report for Section M On the same morning other members of Section E joined with Section H (Anthropology) in the symposium, "The Antiquity of Man" Among other contributions to the discussion, a paper by Philip S Smith emphasized the close relations between Alaska and Northeast Asia The relatively shallow platform between the two continents shows many features diagnostic of submergence, and it is quite possible that there have been repeated periods of continuity between Asia and North America In the Pleistocene, when the northern United States and Canada were ice-bound, Alaska had a genial climate with abundant vegetation, and this region might well have proved attractive to man and other animals At no subsequent time has the passage between the two continents offered a serious barrier to man Dr Boas, president of the association, stressed the probability that man in America was of North Asiatic origin There is a remote similarity in the languages of America and of Siberia, but within the Americas such diversity that several thousand years would seem necessary for differentiations It is still uncertain whether there was one main migration followed by subsequent differentiations in America, or successive waves of previously evolved types Either one implies a long period of time, but whether this extends back as far as the last glaciation is largely a geological problem A further account of this symposium will be found in the report for Section H (Anthropology)

The Seismological Society of America held three sessions on the morning and afternoon of Wednesday, June 17, and the morning of Thursday, June 18

The morning session on Wednesday was devoted to general seismic problems, including papers on possible tidal causes of earthquakes, the structure of the earth and depth of focus In the afternoon new types of seismometers were discussed

On Wednesday evening most of the members attended the lecture given by Dr Arthur L Day

On Thursday evening many of the members attended the meeting of the Branner Club in Los Angeles

SECTION F (ZOOLOGICAL SCIENCES) AND RELATED ORGANIZATIONS

(*Reports from B M Allen and H A Scullen*)

Section F devoted four mornings to symposia. On June 15 it joined with Section G in a symposium on "Genetic Problems" F B Sumner gave conclusions drawn from his outstanding studies on the subspecies of *Peromyscus*, to the effect that the numerous features of these local types are not necessarily correlated with environmental conditions R E Clausen strongly urged the importance of hybridization in the origin of species T Dobzhansky showed that crossing over is less frequent in cases where there had been a rearrangement or inversion of chromosome parts than in cases where the chromosomes have the normal makeup H B Frost gave an account of "Trisomic Inheritance of Red and Double in *Matthiola incana*"

On June 16 Section F joined with the American Association of Economic Entomologists in a symposium upon "The Biology of Termites and Scale Insects" A motion picture film of a termite colony formed a very illuminating feature of this meeting Six papers dealt with the termite investigations being carried on by S F Light and his students at the University of California Other papers presented the studies on scale insects being carried on at the Citrus Experiment Station of the University of California. H J Quayle showed that certain strains of scale insects have recently developed a marked resistance to cyanide control measures which had previously been successful

An account of the joint symposium with Sections B, C and E on "Major Problems of Modern Oceanographic Research" is given in the report for Section E (Geology and Geography) Likewise an account of the symposium with Sections C (Chemistry) and G (Botany) on "Photosynthesis and Photochemistry" is given in the report for Section C

The attendance at the 1931 meeting of the Pacific Slope Branch of the American Association of Economic Entomologists was the largest in the history of the organization, nearly 200 entomologists and their friends being in attendance Many of the papers presented had a bearing on citrus insects The mealybugs and the scale insects attacking citrus trees received most attention in this connection Harry S Smith and F R Cole presented papers on the biological control of the mealybugs. C H Martin presented the results of constant temperature studies on the *Citrophilus* mealybug Biological control, which has played so important a part in insect control work in California, came in for considerable discussion Several interesting miscellaneous papers were presented Otto W Swezy gave a paper on "Some Recent Parasites Introduced into Hawaii" Don C Mote, Howard Stearns and R E Dimick presented a series of three papers relating to the introduction of parasites in the control of the European earwig at Portland, Oregon Another group of papers gave the results of studies which have been made with chemical controls. E R de Ong, Ralph H Smith and Warren G Marshall spoke on oil sprays. Harold

R. Hagan and W. M. Hoskins presented papers on vacuum fumigation

The Entomologists elected the following officers for the coming year *President,* G M. List, *Vice-President,* A M Boyze, and *Secretary-Treasurer,* H A Scullen

The American Society of Parasitologists and the Society of American Bacteriologists arranged a joint program Their meetings opened with a joint session with the California State Veterinary Medical Association on Wednesday morning Infections and diseases of animals received special attention at this meeting, which is reported under Section N Miscellaneous papers were presented at the Thursday morning session

The American Society of Ichthyologists and Herpetologists, Western Division, held a session for miscellaneous papers on Tuesday afternoon Papers were presented by George S Myers, Rolf Bolin, Berry Campbell, J O Snyder, L M Klauber, W L Scofield and Frances N Clark In connection with the meeting there was exhibited a collection of living reptiles of the Southwest

SECTION G (BOTANICAL SCIENCES) AND RELATED ORGANIZATIONS

(*Reports from L R Abrams and B A Rudolph*)

For botanists the general meetings of the association began most auspiciously with the opening reception at the Huntington Library and Art Gallery (See "General Reception") For the most part Section G met jointly with its associated societies, but two joint symposia with other sections were held. On Monday morning Section G joined with Section F (Zoological Sciences) in a symposium on "Genetic Problems," an account of which is given under the report for Section F Thursday morning and afternoon Section G joined with Section C (Chemistry) and the American Chemical Society in a symposium on "Photosynthesis and Photochemistry" An account of this symposium is given under the report for Section C Well over one hundred delegates attended each of these symposia

On Friday a symposium on botanic gardens was held at the Rancho Santa Ana Botanic Garden, in which all the societies associated with Section G participated Mrs Susanna Bixby Bryant, founder of the garden, opened the symposium with a short address of welcome W T Swingle spoke on botanic gardens and their significance to biological research, D H Campbell, on foreign botanic gardens, and H J. Webber, on the need of botanic gardens on the Pacific Coast After the symposium the 165 attending members were guests of Mrs. Bryant at a delightful barbecue luncheon.

The Botanical Society held a meeting Tuesday morning, the Plant Physiologists Wednesday, and the two societies combined in a joint meeting Thursday The program for the meetings was planned with the cooperation of the American Society of Plant Physiologists Twenty-four papers were presented at the meetings in addition to those given at the symposium The dinner for the botanists was held on Thursday evening and about 70 attended. G J Peirce, vice-president of the Physiological Section, presided. W. T Swingle, H. de Forest and President C J Chamberlain gave short addresses Officers for the Pacific Division of the society elected for the ensuing year are *Chairman,* G B Rigg, University of Washington, *secretary,* F D Heald, Washington State College

Thirty-five members were present and twelve papers were presented at the fifteenth annual meeting of the Pacific Division of the American Phytopathological Society L J Klotz and H S Fawcett reported a disease of date palms due to *Thielaviopsis sp* and referred to as "black scorch." It is of considerable economic importance in California, Arizona and North Africa, where the crop at times is greatly reduced by it M B Linford demonstrated that the "yellow-spot" disease of pineapples is of virus origin, and that *Thrips tabaci* Lind is a vector Both larvae and adults may transmit the disease, but adults can not become infective unless they have fed on diseased plants during their larval stage *Emilia sagittata* (Vahl) DC, a weed, also harbors the virus. Linford also found that "streak," a virus disease of canners' peas (*Pisum sativum* L.) could be produced artificially by permitting infective thrips (*T tabaci* Lind) from infected *Emilia sagittata* to feed on healthy peas M Shapovalov showed that healthy tomato plants may be infected with the "yellows" virus by grafting them to infected plants by the approach method The percentage of graft transmitted cases of the disease was merely equal to that of cases induced by direct insect transmission W. W. Mackie and K Esau have found a number of fixed resistant hybrids in both pink and white beans as the result of a cross between Robust, a white pea resistant to mosaic, and California Pink, which is resistant to the virus which produces curly-top in beets Mackie also reported a new disease of maize and beans due to *Rhizoctonia bataticola* (Taub) Butler, which brings about a premature ripening and wilt as well as a reduction in the size of the plant and seed J H Crenshaw and J S Cooley, in their studies of perennial canker, investigated the possible relationship between fertilizer treatment and freezing injury in apple orchards Injuries due to freezing are known to favor the disease. No positive correlation between fertilized treatment and freezing injury was noted. C E. Scott and G L. Stout have succeeded in infecting leaves of almond, apricot, cherry, nectarine, peach, plum and prune in petri dishes by dusting them with the aeciospores of *Tranzschelia punctata* from anemone plants growing near San Jose, California. The aecial stage has never been reported before in the literature as occurring on the Pacific Coast. J S Cooley and E V Shear have found that there exists a definite correlation between the severity of the infection of the perennial apple canker disease and winter precipitation only in areas where the temperature is sufficiently low Winter injured callus tissue is the main seat of infection, and the presence of woolly aphis on callus tissue renders it more susceptible to winter injury Harold E Thomas reported experiments which would indicate the susceptibility of the strawberry to *Verticillium* hadromycosis. The disease usually stunts the plants and may kill them Thomas also has found injection of copper sulphate, acetate or chloride to be very effective in the control of exanthema of deciduous fruit trees The amount of salt required varies considerably under various conditions Copper tartrate, phosphate and carbonate failed to give satisfactory results G H Godfrey and J Oliveira showed with excellent slides and photographs the life cycle of *Heterodera radicicola* in the roots of pineapple and cowpea. The life cycle of this nematode is much longer in pineapple roots

ORGANIZATIONS RELATED TO BOTH SECTIONS F AND G

(*Reports from B. M. Allen and H de Forest*)

Meetings for the reading of papers were held on June 19 and 20 jointly by Section F and the Western Society of Naturalists J H Wiedemann pointed out that animals which feed upon sterile food, as for instance *Hirudo medicinalis*, have a portion of their alimentary tract specialized as a culture chamber for bacteria which aid in the breaking up of food This structure is absent in those forms which ingest bacteria that perform this function. J R Slonaker showed that optimum weight, spontaneous activity, fertility, length of productive span and length of life of rats is attained by 14 per cent. protein diet, lower and higher percentages being far less favorable F. B. Sumner found that the well-known loss of melanin pigment in the skin of fishes in darkness and increase of pigment in light is due to corresponding changes in the amount of pigment and the number of pigment cells. Apparent expansion and contraction of pigment cells was found to be due to diffusion or concentration of melanin granules within the cell.

The Western Society of Naturalists met jointly with the Ecological Society of America on Saturday morning. G H Abbott pointed out that the alternative to the theory of evolution does not necessarily involve a theological controversy—that, in other words, it is possible to conceive of the spontaneous separate origin of diverse forms of life C A. Bothamley and F M Baldwin gave quantitative determinations of the intensity of ultra-violet light in the sunshine of southern California at different elevations from sea level to 5,000 feet They demonstrated that the intensity varies directly with the altitude and inversely with the humidity A L Herrera, of Mexico City, presented two papers upon the production by methylic nitrated sulfoaldehyde of forms simulating living forms

The Ecological Society of America met on Wednesday and Thursday with an attendance varying from fifty to seventy-five On Tuesday a number of entomological papers were given by Hawaiian members On Thursday morning an informal discussion was held on "Ecological Problems of the Pacific Coast Region" Communications from B E Livingston, Frederic E Clements and William S Cooper were read at this meeting

The various field trips arranged by the Ecological Society proved an enjoyable adjunct of the meeting The Mount Lowe-Mount Wilson trip filled a special train and a sufficient number braved the high temperatures of the Colorado Desert of California to necessitate an automobile bus and several cars The excursion to the Rancho Santa Ana Botanic Garden, with the barbecue luncheon so courteously provided by the owner, Mrs Susanna Bixby Bryant, proved a delightful event On Friday evening the Ecological Society, the Western Society of Naturalists and Section F held a dinner at the Hotel Constance in Pasadena.

SECTION H (ANTHROPOLOGY) AND RELATED ORGANIZATIONS

(*Report from C H. Danforth*)

Section H, meeting jointly with the Pacific Division of the American Anthropological Association, held sessions from Tuesday to Saturday, inclusive, with an average attendance of about 80 On Thursday and Friday there was a joint symposium in which members of Section E participated All meetings were under the auspices of the Southwest Museum, where a dinner for attending anthropologists was held on Friday.

The symposium, and many of the contributed papers, centered on the question of early man in America. It may be said that on the whole the prevailing view would seem to be that there is no convincing evidence for great antiquity of man on this continent That man was contemporaneous here with certain mammalian species now extinct was rather generally admitted, but with a disposition to attribute this association not so much to the early appearance of man as to the recent disappearance of some of the lost mammals For example, the Rancho la Brea deposits are considered by some as much more modern than formerly supposed In Shelter Cave the dung of extinct mammals has been reported to contain remains of plants identified with those of the present local fauna. Various evidence of this sort supports the view that there is little indication that man was present in America earlier than the beginning of the Modern Period or the end of the late Pleistocene

A trenchant survey of the Pleistocene fauna with reference to early man in America was presented by A S Romer, who discussed mammalian sequences and entered into a brief analysis of the views of Cope, Osborne and Hay Evidence was presented to show that many of the forms which were supposed to have become extinct in the early Pleistocene were still present in late Pleistocene, if not actually in the present era What disturbing feature caused the sudden extinction of many of these forms at a relatively late date is unknown There is a remote possibility that the appearance of man may have contributed to this end As yet there is no evidence that man was on this continent earlier than the end of the Wisconsin glaciation and beginning of modern time Chester Stock dealt more specifically with the vertebrate series in the southwest, emphasizing the relatively recent date of Rancho la Brea and other deposits He placed the Gypsum Cave finds at a period between Upper Pleistocene and Lower Recent Douglas Johnson commented on the difficulties geologists as well as anthropologists encounter in dating formations and called attention to various sources of error He agreed with the preceding speakers that finds involving human remains and artifacts are all relatively recent—at most, less than ten to twenty thousand years A further account of this symposium is given under the report for Section E

Especially interesting accounts of the discoveries and progressive investigations in the Gypsum Caves and Folsom region were presented by M R Harrington and Barnum Brown The former called attention, among other matters of interest, to some painted darts which probably are the oldest examples of the decorative art from this continent

Other papers dealt with early man in Southern California and in Texas, burial mounds in Oregon, pottery and changing cultures in Northwestern United States, and cultural links between North and Central America H B Alexander spoke on the sense of antiquity in Indian mythology Cultural traits found along the West Coast were discussed by E M. Loeb J H Seward and Albert B Reagan dealt with the archeology of Utah. In an extended study of pictographs the latter found evidence of early Basket Maker and Pueblo cultures which were superseded on the invasion of an aggressive Head Hunting group Later superimposed drawings suggest that the invaders were akin to Indians found in the region by white men

SECTION I (PSYCHOLOGY) AND RELATED ORGANIZATIONS

(*Reports from John E Anderson, Wayne L Morse, and Robert H Seashore*)

Section I held no sessions of its own since it was the judgment of individuals on the coast that the Pasadena meeting was too close in time to the Oregon meeting of the Western Psychological Association to warrant holding a session Members of Section I met with the Social Science Research Council, Pacific Regional Committee Of particular interest to psychologists were the round table discussions on "Law Enforcement and the Prevention of Crime" and "The Description and Measurement of Personality Traits"

Approximately ninety persons attended the round table on "Law Enforcement and the Prevention of Crime" Discussions during the round table session for the most part centered around the contributions of psychology to scientific explanations of criminal behavior, the contributions and values of the several crime surveys, the investigation of American penal methodology as compared with English and Continental, and legal aspects of criminology It was emphasized that, to date, psychology has taught us very little about the forces which produce so-called criminal conduct and that much research remains to be done in the field of abnormal psychology It was urged that social scientists, especially sociologists and psychologists, have much to do in the way of studying scientifically the many complex problems connected with penal treatment Specific suggestions, such as more liberal parole and probation systems, industrialization of prisons and the elimination of the punitive theory in the treatment of criminals, were discussed It was very clear that those in attendance were not in agreement as to these issues

The discussions at the round table on "The Description and Measurement of Personality Traits" were opened by brief reports and suggestions from Dr E R Guthrie, Dr R H Seashore, Dr H C. Conrad, Dr Kate Gordon and Dr H Merrill The sampling of behavior was suggested as the principal approach for measurement and description of individual differences Advantages cited were the direct empirical basis of description and the practical value as shown in basing credit ratings, for instance, upon a report of the individual's previous conduct of his financial affairs Descriptions of "inner" personality as inferred from behavior were considered open to criticism and less verifiable Fallacies underlying loose terminology in this relatively new field include especially terms such as "general abilities" and "capacities" where experimental evidence indicates a high degree of specificity of different activities

Difficulties underlying physiological interpretations of observed behavior were illustrated by recent experiments on sensory and motor activities in which hypothetical constants of nerve and muscle speeds did not seem warranted The bearings of these findings upon verbal tests were also considered

Practical aspects of individual differences should include the improvement of training methods and the adaptation of tools and working conditions to the individual as well as personnel methods which now receive the major emphasis The stability of individual differences need not imply a hereditary basis although it is an evidence of their practical importance

SECTION K (SOCIAL AND ECONOMIC SCIENCES) AND RELATED ORGANIZATIONS

(Reports from C F Roos, E B Price, Erna Gunther, H E Erdman, E G Mears, E B Price, H F Angus, C L Alsberg and John Parke Young)

Section K met with the Pacific Coast Regional Committee of the Social Science Research Council in its first conference held on the Pacific Coast The joint committee responsible for the excellent well-balanced program consisted of Dr William B Munro, *chairman*, Dr F J Teggart, Dr C L Alsberg, Dr E S Bogardus, Dr T H Boggs, Dr H S Grady, Dr A B Hall, Dr J P Harris and Dr G S Watkins The membership of the conference was selected with considerable care, particularly in the matter of leaders of round tables, to include those actively engaged, or having an effective interest in actual research in the social sciences Two morning sessions were given over to round tables, attendance at which was by invitation only

Gathered at the round table conference on "Quantitative Methods in the Social Sciences" were representatives from economics, agricultural economics, engineering, political science and anthropology Dr Tolley stressed the fact that a wider knowledge of mathematics was essential to the social scientist who would use quantitative methods Dr Titus called attention to the great gap at present between some of the conclusions in the social sciences and the practical applications of these conclusions In perfecting a highly involved technique for the solution of problems that concern modern life are we losing sight of ways and means to apply that newly gained knowledge for the benefit of our society? Dr Charles A Beard pointed out that even the engineer can profit immensely by exact data that the social scientists can furnish Exact and quantitative methods can often be used to check conclusions subjectively derived, and through such a check to establish greater faith in the subjective method which must be used more frequently The conclusions reached were that quantitative methods may aid in accurate thinking but they should not be regarded as substitutes for it

At the round table on "American Foreign Policy and Foreign Trade" the chairman, Dr Eliot G Mears, outlined the main trends in American foreign trade in the calendar year 1930 contrasted with 1929 Exports suffered a decline of 19 per cent in quantity and 27 per cent in value, while imports dropped 15 per cent in quantity and 30 per cent in value, thus reflecting clearly the world-wide depression aggravated by a greatly depressed price level Of important buyers of American goods only Soviet Russia made heavier purchases in 1930 than in 1929, advancing from sixteenth to eighth place among export customers The rapid growth since 1920 of the number of American industrial plants established abroad was actuated by both public and private economy resulting from increased nationalism everywhere reflected in governmental barriers and domestic sentiment against foreign-made goods The strong pressure exerted in each country by private interests favored local production and local markets

At the round table on "Problems of Urban-Rural Relationships" it was pointed out that a number of problems arise out of the flow of population from farm to city There appears in the offing a substantial body of farmers who may have to revert to a self-sufficient type of agriculture because they lack ability or capital to adopt modern methods Decentralization of industry may offer many of these industrial jobs Good roads about all industrial centers tend to induce many industrial workers to devote part of their time to small-scale agricultural pursuits in suburban regions Another group of problems arises out of taxation and spending for such purposes as schools and roads in sparsely settled sections In the case of roads the urban residents are often more interested than the rural residents Agencies for the solution of urban-rural problems have not developed It would be better for existing urban and rural agencies to work together rather than to suggest additional agencies

Another phase of sociology received attention at the round table on "Immigration Problems on the Pacific Coast Mexican, Filipino and Second Generation Japanese" Professor E A Ross spoke of the general aspects of the immigration problem. He argued that the falling death rate due to scientific advances in Asiatic countries would give rise to a rapid expansion of their population, which would in turn tend to lower the standard of living He contended that the greatest service which the United States could render to humanity would consist in maintaining its high standards of individual welfare by whatever exclusion might be necessary, and thereby force the Asiatic countries to reduce the pressure of population by birth control

The session on "The Problem of Tax Reform," was opened by Dr Milbank Johnson, but the chair was soon taken by Mr R A Vandergrift Discussion began with agreement that the general burden of taxation was becoming unduly heavy, largely because the costs of government administration were going up, but largely also because in much of the country there have been too heavy permanent investments, such as roads, schoolhouses, etc This led to a discussion concerning the need for more direct taxation, so as to bring the tax burden home to each individual. The earmarking of tax money, as in the gasoline tax, for a specific purpose was criticized and defended In that connection, the taxation of motorbus and truck lines was touched upon

Other round tables of particular interest to members of Section K were held on the subjects "Prevention of Business Depressions" and "Social Sciences in Relation to Legal Education" Still other round tables are described in the reports for Section I (Psychology) and Section L (Historical Sciences)

At the first noon luncheon meeting, the speaker was Dr Charles A Beard, President Arnold Bennett Hall, of the University of Oregon, presiding One of the most interesting of all the meetings was the second luncheon meeting at which a symposium on "The Relation of the Natural and Social Sciences" was held The speakers on this occasion were Dr E A Ross, Dr A Goldenweiser and Dr C L. Alsberg.

A feature of the second afternoon was a general meeting of those attending the conferences, where it was decided to continue the conference another year and to entrust to the Pacific Coast Regional Committee of the Social Science Research Council the task of preparing a program for the next meeting, drawing up a provisional constitution and selecting officers and members This meeting was followed by a reception given by Professor and Mrs William Munro in Dabney Hall Gardens.

SECTION L (HISTORICAL AND PHILOLOGICAL SCIENCES) AND RELATED ORGANIZATIONS

(Reports from D E. Clark, John C Parish, R. G. Gettell and H. B Alexander)

Section L met jointly with the Pacific Coast Regional Committee of the Social Science Research Council as did Sections K and I Attendance at sessions was by invitation and all sessions were crowded.

Professor R G Cleland, of Occidental College, presided at the round table discussion on "Geographic Factors in Pacific Coast History" The other participants whose names appeared on the program were Professor J M Vincent, of Johns Hopkins University, Dr G M McBride, of the University of California at Los Angeles, and Professor D E. Clark, of the University of Oregon. It was pointed out that the discovery of rich gold fields and the harbor facilities of San Francisco aided materially in the development of California Special note was made of the fact that Southern California is one of the best illustrations of man's conquest of geographical handicaps such as isolation, aridity and lack of ready-made harbors. The determining influence of the Columbia River in the Pacific Northwest in early exploration, fur trade and settlement was pointed out, as were also the differences in development caused by geographic conditions east and west of the Cascade mountains A point of some interest was the fact that natural boundaries have been ignored in the location of political boundaries in the region known as the Inland Empire

At the round table on "The Conservation of Historical Materials on the Pacific Coast" it was said that the greatest conservation need is cooperation The libraries of the coast are highly developed as an instrumentality for the conservation of books and pamphlets, but much progress can be made by agreements under which selective buying in special fields may be carried on so as to avoid unnecessary duplication especially with reference to expensive sets and sources To preserve newspapers there should first be made a wise selection of files and these housed in repositories which can give adequate physical care and general availability. There should be a calendar giving the location and general description of the various files which have been preserved. Historical museum materials are of great value, but it is obvious that cooperative discussion and study of the principles involved and the purposes to be achieved would result in a much more adequate fulfilment of the function of such illustrative material.

Chief attention at the round table on "The Formation of Public Opinion and the Reorganization of Political Parties" was given to the nature of the party system, especially in the United States, to the functions performed by parties, the issues upon which they are based and the possibilities of reorganization and improvement. It was said that the present party alignment makes it impossible to get an expression of public opinion on any single issue because of the cross-currents and cleavages in the present parties. The majority of those present were doubtful of the desirability and possibility of forming an effective third party, but believed that progress could be made in improving the organization and methods of existing parties. The causes of the political indifference of many intelligent people were said to be the difficulties of the long ballot and of numerous referendums.

After opening the conference on "The Philosophic Implications of Recent Advances in the Natural Sciences" the chairman, Professor H. B. Alexander, of Scripps College, called upon Professor A. Goldenweiser to begin the discussion.

Professor Goldenweiser stressed the fact that certain philosophical concepts defining the general nature of structure are receiving significant demonstration in the very effort of physical science to define its phenomena. The concepts upon which he dwelt were level, system and pattern, and he indicated the analogues for each of these which the science of physics has been compelled to assume in its discriminations of the atomic levels, the subatomic and the more recent efforts to describe the stellar universe in the concepts of relativity. On each of these levels he pointed out that distinct and valid systems emerge. The Newtonian system for example being unaffected by more recent discoveries when taken on its own level, while at the same time there are remarkable conformities in the general pattern of these systems. Professor Joseph Mayer, of Tufts College, dwelt upon the great interest to philosophy which issues from the importance given to the function of the observer in recent theories, qualifying that of course he understood by the observer merely one of the elements of description and not at all an external agent. He also laid stress upon the fact that physical method is in the last analysis statistical and by nature is therefore unable to give any final detailing of fact. Professor Hugh Miller, of the University of California at Los Angeles, felt that the epistemological problems of philosophy had not been essentially advanced by the new order of physical concepts, while Professor T. G. Soares, of the California Institute, pointed out that the doctrine of values had been already introduced by the other speakers in their concession of the concept of importance as governing all scientific methodology. The conference was closed by Charles S. Beard who, raising the question, "What is Philosophy?" expressed the opinion that all philosophy is an especial if somewhat adventitious flourish of the historical consciousness.

SECTION M (ENGINEERING)

(Report from R. L. Daugherty)

Section M held three sessions at Pasadena. On Thursday morning it joined with Section E (Geology and Geography) in a seismology engineering symposium. Progress in the recording of strong earthquake motions was reported by N. H. Heck, who stated that the greatest development along this line has been made in Japan. Mr. S. B. Morris, chief engineer of the Pasadena Water Department, told what his department has done to offset possible effects of earthquakes on the dam in San Gabriel Canyon. Dr. R. R. Martel gave a technical address devoted to the development of equations necessary for the solution of certain problems of static stresses in connection with buildings designed to withstand earthquakes. Other papers were given by Perry Byerly, Walter T. Steilberg, J. A. Anderson, J. P. Buwalda and Bailey Willis.

The symposium on the Colorado River dam and aqueduct was opened by Ruth E. Baugh who gave a comprehensive review of Los Angeles' efforts to obtain an adequate water supply. E. F. Scattergood, of Los Angeles, continued with an address on the economic significance of the Boulder Canyon project power. He predicted that within ten years after the completion of the Hoover Dam California's property and industrial wealth will have multiplied seven times. W. S. Peterson, also of Los Angeles, told of transmission problems that would have to be faced in the Colorado River project. Julian Hinds outlined engineering studies for the aqueduct.

On Friday morning Maurice Holland, director of the division of engineering and industrial research of the National Research Council, gave an address, "Industrial Research—A Gilt-edge Security." He declared that in the highly competitive struggle for industrial supremacy the march of science, discovery and invention has so speeded up the advance of technology that a laboratory discovery may mean the creation of a new industry, or expansion of one and losses for another. Stress was laid on the fact that large industries must keep ahead or abreast of the scientific trend or be lost, and that research has become one of the major securities of the permanence of an organization.

SECTION N (MEDICAL SCIENCES) AND RELATED ORGANIZATIONS

(Reports from S. G. Mudd, John F. Kessel and T. D. Beckwith)

For the most part Section N met with its associated societies, the Society of American Bacteriologists, the American Society of Parasitologists and the Society for Experimental Biology and Medicine. By invitation the California Veterinary Medical Association met with Section N On Thursday forenoon Section N attended the symposium arranged by Section B (Physics) on "The Production of High Energy Electrical Particles" The following morning the program consisted of a symposium with Section B on "High Voltage X-ray Tubes and Their Medical and Biological Possibilities" Dr Curtis F Burnam reviewed the present situation concerning ray treatment of malignancies and commented on what might be hoped for with high voltage methods Of unusual interest and importance was the report of Dr Arthur Desjardins, of Mayo Clinic, who discussed the radio-sensitiveness of cells and tissues Papers of clinical value were read by Dr R R Newell, Dr Harry Ullmann and Dr Henry Schmitz Preliminary data on depth dose measurements of very hard x-rays were presented by John Blackburn The differential biological effects produced by x-rays and gamma-rays were reported by P S Henshaw The papers were discussed by Dr Robert A Millikan

The Society of American Bacteriologists and the American Society of Parasitologists arranged joint programs for the Pasadena meeting Two morning meetings, 9 00 to 12 15, were devoted to papers and discussions at which nineteen titles were presented One session was held as a joint meeting with the California State Veterinary Medical Association, at which time papers of special interest to animal diseases were given

Among the papers given were two motion picture studies, one by Karl F Meyer, describing the recent epidemic of horses in the San Joaquin Valley caused by a filterable virus, the other a "Motion Picture Study of Amoebiasis," by John V Barrow A paper by J Traum, Department of Veterinary Science, University of California, on "Studies Bearing on the Modes and Sources of Brucella Infections in Man and Animals," with a discussion by R V Stone, of the Los Angeles Public Health Department, was of special significance

Two papers on coccidial infections were given, one by Dora P Henry, of the University of California, and one by R L Rutherford, of the University of Southern California Protozoology was further represented by E W Dennis, who presented a number of new facts concerning the life cycle of *Babesia bigemina*, by Charles A Kofoid and Ethel McNeil "On the Nature and Structure of the Wall of the Cysts of Amoebae of the Human Digestive Tract," and by A J Salle on "Studies on the Metabolism of Leishmania" A paper of special importance in California was one by Dorothy Beck on "Epidemiological Studies with Coccidoides" "The Incidence of *Streptococcus epidemicus* in Southern California" was discussed by C W Bonynge Lyman L Daines reported a study on "The Bacteriology of Skin Lesions in Tuberculin-reacting Cattle," in which the isolation of a pleomorphic organism, similar to the actinomycete isolated by Walker from cases of leprosy, was recorded An outbreak of infectious myxomatosis in rabbits in Southern California, the first outside of Brazil, together with immunological studies on myxomatosis, was reported by John F Kessel and Roy T Fisk T D Beckwith discussed the rôle of bacteria in the reduction of sulphur compounds in the paper and pulp industry Two papers of immunological interest were by W H Manwaring, on "Post-Ehrlich Immunology," and by R W Lamson, on "Typhoid Agglutinins in Man Following Vaccine Injections"

The sessions of the Society for Experimental Biology and Medicine, held in connection with the summer meeting of the American Association for the Advancement of Science at Pasadena, were characterized by programs of high order Attendance was both large and enthusiastic The society convened for two sessions and for these there were offered thirty papers, presented mainly by members residing upon the Pacific Coast The fields covered by the various essayists included the different branches of science within the scope of the society Ten might be classed as physiology, fourteen were biochemical and pharmacologic and six dealt with matters of bacteriology and viruses

SECTION O (AGRICULTURE)

(*Report from E E Thomas*)

Members of Section O of the association attended the sessions of the Western Society of Soil Science, which held its annual meeting on June 15, 16 and 17 The sessions were well attended, with representatives from all the Western states and from Hawaii With twenty papers on the program it was necessary to hold four sessions in order to allow time for discussion One whole session was devoted to a discussion of phosphorus, especially with reference to methods of determining small amounts in soil and the availability of phosphate in different soil types

Officers elected for the coming year are *President*, S C Vandecaveye, *Vice-president*, Willard Gardner, *Secretary-treasurer*, E E Thomas, Citrus Experiment Station, Riverside, Calif

SECTION Q (EDUCATION)

(*Report from W L Uhl*)

Section Q held three sessions for the reading of papers on Monday and Tuesday Dr Edna W. Bailey reported upon the value of the objective study of children in the training of prospective teachers. A program of such study has been in operation for several years at the University of California. The psychology of sharing among preschool children was presented, together with experimental data by Richard C Currier Mr Currier presented the scores made by young children when they face situations in which desired objects may or may not be shared according to the inclinations of the children Frank K Foster presented evidence which indicated that differences in methods may produce greater differences in the effectiveness of learning than differences in subject-matter The data dealt with a controlled experiment in which pupils memorized English-nonsense combinations both with and without pictures Learning without pictures was slightly more effective than with pictures C C Crawford set up criteria for the evaluation of training students for research work Ernest W Tiegs presented the results of his investigation of teachers' attitudes toward scientific method In spite of the fact that many of the teachers had been trained in courses dealing with scientific method, nearly half of them assumed traditional attitudes toward the educational problems with which they were confronted The relation between problems of cerebral dominance and speaking and reading defects was presented with experimental data by Milton Metfessel The application of nomograms to problems in educational statistics was described by Raymond C Perry, who presented numerous slides which showed the use of the nomograms that he has developed M E Broom presented a paper on the relation of general information and mental ability to silent reading at the college level His data indicate that although information is very important in case of the upper half of the readers, still greater differences among the entire group of readers were found to be due to differences in intelligence Three papers were presented upon the general problem of scholastic marks in secondary schools and the reliability of such marks as bases for predicting scholastic success W H Hughes presented data which showed closer agreement among the personal attitudes which teachers ascribed to their pupils than among the academic grades achieved by the same pupils W L Uhl presented closely related data which have been found under the general direction of August Dvorak These data enable one to employ regression coefficients in the predicting of college success By using these coefficients upon students of high-school grades the amount of error is reduced about 50 per cent as compared with the error when raw grades are used John W Harbeson presented a large amount of similar corroborative data drawn from high-school and junior college studies which he has made Charles C Weidemann presented the results of the study of a scoring key for true-false and indeterminate examinations in the history of education Instructors in this subject were asked to pass judgments upon the truth or falsity or doubtful character of 160 statements in the history of education By obtaining judgments upon a point scale some of the objections to the use of true-false examinations seem to have been obviated The present status of elementary business training in the public junior high schools of the United States was presented by Benjamin R Haynes One of the chief points in his findings is that many of the commercial subjects are moving upward rapidly into the senior high school Grace M Fernald gave the results of special remedial reading technique She included demonstrations of her varied procedures by having two non-reading pupils perform before the group Betty Trier Berry presented somewhat closely related data upon the improvement of reading at the college freshman level The practical application of methods of recording the observations of classroom instruction was presented by means of charts and tables by John Waage, who has modified the Morrison and Barr technique so that he can use this technique in his own supervisory activities

OBITUARY

EDWARD HART, 1854–1931

Dr. Edward Hart, professor emeritus of chemistry of Lafayette College and member of the faculty since 1874, died at his home on Saturday, June 6, in his seventy-seventh year He is survived by his wife and seven children

Dr Hart was born in Doylestown, Pennsylvania, and studied law for two years, after which he went to Dr Thomas M Drown in Philadelphia to study chemistry They came to Lafayette together in 1874, the young Hart ranking as assistant During 1876 and 1877 he was at Johns Hopkins University with a fellowship under Dr. Remsen and he is believed to have been the first one to receive the Ph D degree from that institution

Dr Hart published numerous papers and he took out many patents, particularly for his nitric acid condenser and ceresine bottle for hydrofluoric acid, for the latter of which he was awarded the John Scott Medal He became editor of the *Journal of Analytical Chemistry* in 1882, one of the first journals in America devoted exclusively to chemistry Later, in 1892, he was appointed editor of the *Journal of the American Chemical Society* and it was decided to merge the two journals Dr. Hart had already started a printing establishment in 1887

SCIENTIFIC EVENTS

THE BRITISH NATIONAL COLLECTION OF TYPE CULTURES

The British Medical Journal points out that the establishment of the National Collection of Type Cultures of Bacteria and the issue of the first catalogue in 1922 marked an important step in the development of bacteriology in England Before that date there was no official repository for bacterial cultures in that country Individual bacteriologists kept their own collections, but there was no organization for the permanent preservation of pure cultures and for the supply of correctly labelled cultures to laboratory workers who required different species of bacteria for teaching purposes or for comparison with recently isolated strains The *Journal* states that since this work was undertaken at the Lister Institute under the supervision of Professor Ledingham and Dr St John-Brooks the museum has grown to such proportions that it now contains more than three thousand different strains of micro-organisms The demand for the cultures has increased to such an extent that more than five thousand cultures are being distributed to workers throughout the world each year The latest catalogue is an enlarged and revised edition of the list published in 1925 The different strains are catalogued alphabetically, each entry giving details of the type, group or variety of the strain, the name of the person and institution supplying the strain, and in some cases particulars of the source from which the micro-organism was isolated An attempt has been made to reduce the numbers of organisms appearing under the general heading of "bacterium" or "bacillus" by segregating some of the more natural groups and entering these as separate genera. This arrangement, it is pointed out, imposes a little inconvenience on those who are still accustomed to refer to bacteria by their old-fashioned names. For instance, *B typhosus* must now be looked for as *Salmonella typhi*, and *B tuberculosis* as *Mycobacterium tuberculosis* In all such cases, however, ample cross-references are given for the benefit of those more familiar with the older system The Medical Research Council expresses the hope that this new edition of the catalogue will tend to direct the attention of bacteriologists in this and other countries to the continued need for the deposition of strains of bacteria and fungi for maintenance and reference in this collection

THE NEW OBSERVATORY OF THE UNIVERSITY OF KENTUCKY

THE new astronomical observatory on the University of Kentucky campus which is situated on the Experiment Station farm and which has just been completed and equipped at a cost of approximately $25,000 will be ready for use with the opening of the fall term

The observatory building is modern in every respect, and has been constructed with a view to accommodating more comprehensive equipment in the future It consists of a first floor plan which includes classroom, combination office and library, laboratories and space for pictures and transparencies, a basement and a dome room

The dome room is a 22-foot circular room which will accommodate the eight-inch equatorial telescope now owned by the university and is planned to accommodate a 12-inch telescope The dome is to be motor-driven At the rear of the building is a transit room which in the future will house a small transit instrument The basement contains a dark room for developing pictures, a small classroom, work room and furnace room with modern gas furnace and storage space

On the roof, over the office library and classroom are observation decks for use in studying stars and constellations and over the foyer is a parapet for use in map work

The department of astronomy is a division of the department of mathematics and astronomy with Dr Paul P Boyd, dean of the College of Arts and Sciences, as head The work is in charge of Dr H H Downing, professor of mathematics, and Professor D E South, assistant professor of mathematics

In the past the department of astronomy offered one or two semesters of practical astronomy which consisted of problems of time, latitude, longitude and position, the use of instruments and the collection of observational data for the solution of these problems However, this work was done with borrowed engineering instruments and some home-made apparatus

At present the department of astronomy offers one year of descriptive astronomy, which is a beginning course dealing with sizes, distances, masses, densities, speeds, revolution, rotations, etc, of the planets, satellites, comets, meteors, asteroids, stars, clusters and nebulas Also one or two semesters of celestial mechanics

With the opening of the next academic year a course in the history of astronomy will be offered for the first time in addition to the other courses New courses will also be added from time to time as the demands require and the teaching staff permits

SUMMER SESSION OF TEACHERS OF CHEMICAL ENGINEERING

ACCORDING to *Industrial and Engineering Chemistry*, under the auspices of the Society for the Promotion of Engineering Education, a summer session for teachers of chemical engineering was held at the University of Michigan from June 24 to July 9 Seventy men, representing 47 colleges located in 25 states, from Washington and California on the west to Massachusetts and North Carolina on the east, and from Louisiana on the south to Minnesota and Montana on the north, were registered for the meeting In addition to visitors, many of whom stopped over for a day or more, a large staff of distinguished lecturers was in attendance

Three main series of lectures were delivered, covering the unit operations of chemical engineering, recent advances in chemical technology, and methods of conducting laboratory courses in the unit operations The speakers included

H A Curtis, Vacuum Oil Co , W. K Lewis, Massachusetts Institute of Technology, R. E Wilson, Standard Oil Co of Indiana, W L Badger, University of Michigan, R. S Tour, University of Cincinnati, Zay Jeffries, The Aluminum Co of America, H L Olin, University of Iowa, J C Olsen, Brooklyn Polytechnic Institute, Clifford Paige, Brooklyn Union Gas Co , A V H Mory, Bakelite Co , O R. Sweeney, Iowa State College, W L Beuschlein, University of Washington, C C Furnas, Yale University, L V Burton, *Food Industries*, S D Kirkpatrick, *Chemical and Metallurgical Engineering*, E S Rothrock, Louisiana Chemical Co , George Oenslager, B. F Goodrich Co , A W Hixson, Columbia University, G H. Montillon, University of Minnesota, A. Anable, The Dorr Co , A K Brodie, Procter and Gamble, R A Hayward, Kalamazoo Vegetable Parchment Co , B F Dodge, Yale University, G A Bole, Ohio State University, C O Brown, Chemical Engineering Corp , G G Brown, University of Michigan, E C. Sullivan, Corning Glass Co , H. C Hottel, Massachusetts Institute of Technology; W H McAdams, Massachusetts Institute of Technology, J C Brier, University of Michigan

The members of the session, lecturers and visitors were housed in Jordan Hall, one of the university dormitories. This arrangement facilitated interchange of ideas, and discussions held informally over the dinner table and in the parlors

A social committee provided many opportunities for exercise and play. Golf, tennis, swimming, canoeing, hiking, baseball and bridge afforded relaxation in the afternoon. A smoker, at which an informal talk was given by Professor H H Bartlett, of the department of botany, on his experiences while working on the rubber plantations of the Dutch Indies; a bridge party; a tea, and a picnic on the Fourth of July with baseball and horseshoe pitching, provided additional entertainment. There was a trip through the River Rouge works of the Ford Motor Co., and a banquet, at which L. R. Newburgh, research professor of medicine, spoke on "The Human Body as an Internal Combustion Engine "

The summer session was under the general direction of H P Hammond, representing the Society for the Promotion of Engineering Education The local director was A H White, and the secretary, W L McCabe Generous financial support was given by the University of Michigan and by the Chemical Foundation, Inc

THE SCHENECTADY MEETING OF THE AMERICAN PHYSICAL SOCIETY

THE one hundred and seventy-second meeting of the American Physical Society will be held at Schenectady, New York, on September 10, 11 and 12 Registration will be at the Research Laboratory of the General Electric Company throughout the first morning At 10 A M a meeting for ten-minute contributed papers will be held at Rice Hall, followed by a luncheon for members at the Works Restaurant and an inspection trip through the laboratories The annual dinner will be held in the evening at the Mohawk Golf Club A meeting to commemorate the one hundredth anniversary of the notable experiments of Michael Faraday and Joseph Henry on electromagnetic induction will be held at 9 A M on Friday, when a paper on Faraday written by Sir William Bragg will be read by Professor John Zeleny A paper on Joseph Henry will be presented by Professor W F Magie After the memorial meeting informal group discussions will be held The luncheon at Union College will be given at one o'clock In the afternoon a trip will be taken to Lake George This will be by special train to the lake and will include a three hour sail with dinner on board the steamer, provided a sufficient number of members wish to attend On Saturday morning there will be a symposium on magnetism, followed by informal group discussions as on Friday One of these groups is planning for a rather intensive discussion of present-day experimental and theoretical aspects of magnetism for those particularly interested in this field This group will not meet on Friday Saturday afternoon will be devoted to sports. Arrangements will be made for guest cards at the various golf clubs and tennis courts will be available

THE FILTERABILITY OF BACTERIA

THE James A. Patten Lecture was given at Northwestern University on July 22 by Professor Arthur Isaac Kendall, of the Department of Research Bacteriology, Northwestern University Medical School, Chicago. The subject was "Observations upon the Filterability of Bacteria, including a Filterable Organism Obtained from Cases of Influenza."

Professor Kendall reported that a heat sterilizable protein medium (K medium) had been prepared for the cultivation of bacteria Organisms, some in the filterable state, had been grown from the blood of cases of influenza, common cold, measles (in one instance thirty hours before the appearance of the rash), rheumatic fever, arthritis and endocarditis Also, Staphylococci had been obtained in non-filterable states from Staphylococcus bacteriophage and Besredka (Staphylococcus) antivirus Laboratory cultures of *B typhosus*, *B coli*, Staphylococci and Streptococci, grown in K medium, had been rendered filterable through Berkefeld filters After filtration, these organisms, by suitable procedure, had been regained in non-filterable form.

The lecturer reported that many bacteria pathogenic for, or parasitic upon man and lower animals may and do exist in two states, filterable and non-filterable A chemical explanation for the existence of these two states, filterable and non-filterable, was proffered, and relation of these two states to microbic existence and infection was indicated

SCIENTIFIC NOTES AND NEWS

Dr William H Howell, who recently retired as director of the Johns Hopkins University School of Hygiene and Public Health, has accepted the chairmanship of the medical section of the National Research Council Dr Howell has also been elected chairman of the executive committee of Science Service

Dr James T Jardine, director of the Oregon Experiment Station at Corvallis, has been appointed director of the Bureau of Experiment Stations of the U S Department of Agriculture He succeeds Dr E W Allen, who died more than a year ago Mr Jardine has also been appointed assistant director of scientific work in the department He is a brother of Dr William M Jardine, formerly Secretary of Agriculture, who is now minister to Egypt

At the commencement of Oberlin College, the doctorate of science was conferred on Dr Charles E St John, astronomer of the Mt Wilson Observatory of the Carnegie Institution

The University of Liverpool will confer in December the degree of doctor of laws on Dr C G Baikla, professor of natural science in the University of Edinburgh

Dr. Cornelius Betten, since 1923 director of resident instruction, has been named acting dean and director of the State Colleges of Agriculture and Home Economics at Cornell University to fill the vacancy created by the promotion of Dean Mann to the office of provost of the university Dean Mann will take up his new duties on August 1, and Dr Betten will serve until a permanent dean is chosen

Dr F W DeWolf, formerly state geologist of Illinois, has been appointed head of the department of geology at the University of Illinois, to succeed Dr W. S Bayley, who has retired

Dr Robert Tait McKenzie, professor of physical therapy and physical education in the University of Pennsylvania School of Medicine, has been appointed research professor of physical education

Dr Alfred R Radcliffe-Brown, the British ethnologist, now of the University of Sydney, Australia, has been appointed professor in the department of anthropology of the University of Chicago He will give courses on "Primitive Society," "Primitive Religions," "Ethnology of Africa," "The Australian Tribes," "Family, Kin and Clan," and "Economic and Political Institutions of Primitive Peoples"

Dr Paul A Warren, professor of botany at the College of William and Mary, has been appointed professor of botany at Tufts College

Promotions to full professorships at the University of Chicago include A S Romer, geology, R S Mulliken, physics, B H Willier, zoology, and H E Hayward, M C Coulter and J M Beal, botany.

Dr Allan C G Mitchell, who has been fellow of the Bartol Research Foundation of the Franklin Institute for the past three years, has been appointed assistant professor of physics at New York University

Dr C. W Stiles, of the U S Public Health Service, who will go on the retired list on August 1 after forty years of active service, has altered the plans recently announced in Science His permanent address in the future will be Washington, D C; he will be in Winter Park, Florida, during the winter months

Professor F Easton Carr, head of the astronomy department of Oberlin College, will spend his sabbatical year at Mt Wilson Observatory in California.

Dr. William Mann, director of the National Zoological Park at Washington, D C, sailed on July 22 for Georgetown, British Guiana, to obtain specimens for the Guiana group of the park He was accompanied by Mrs. Mann and Frank Lowe, assistant head keeper at the zoo, who will aid in capturing and caring for the animals obtained.

SCIENCE

Vol. 74 FRIDAY, AUGUST 7, 1931 No. 1910

Observations upon the Filterability of Bacteria, including a Filterable Organism Obtained from Cases of Influenza: PROFESSOR ARTHUR ISAAC KENDALL 129

Arrest of Geologic, Archeologic and Paleontologic Work in Central Asia: PRESIDENT HENRY FAIRFIELD OSBORN 139

Obituary:
Aldred Scott Warthin: DR. PEYTON ROUS. *Memorials; Recent Deaths* 142

Scientific Events:
The Jubilee Meeting of the British Society of Chemical Industry; the [illegible] *Bureau of Surgical Research; the Sixth International Congress of Genetics* 144

Scientific Notes and News 146

Discussion:
Reduction of Oxyluciferin by Atomic Hydrogen: PROFESSOR E. NEWTON HARVEY and DR. G. I. LAVIN. *"The Possible Rôle of Micro-organisms in the Precipitation of Calcium Carbonate in Tropical Seas"*: DR. CHAS. B. LIPMAN. *Inherited Taste Deficiency*: DR. L. H. SNYDER. *Getting the Student to* [illegible]: DR. M. LOUISE NICHOLS. [illegible]: PROFESSOR FRANK C. GATES 150

Societies and Academies:
The North Carolina Academy of Science: DR. H. R. TOTTEN. *The Virginia Academy of Science*: DR. E. C. L. MILLER 153

Scientific Apparatus and Laboratory Methods:
Ruthenium Tetroxide as a Fixative in Cytology: DR. D. C. CARPENTER and DR. B. R. NEBEL. *Method for Locating the Larvae of the Mosquito Mansonia*: T. E. MCNEEL 154

Special Articles:
On Atmospheric Electricity: PROFESSOR C. S. DORCHESTER and PROFESSOR L. W. BUTLER. *Use of Protozoa in Measuring the Neutralizing Value of Cobra Anti-Serum*: DR. CHARLES H. PHILPOTT 155

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

OBSERVATIONS UPON THE FILTERABILITY OF BACTERIA, INCLUDING A FILTERABLE ORGANISM OBTAINED FROM CASES OF INFLUENZA[1]

STUDIES IN BACTERIAL METABOLISM, CI

By Professor ARTHUR ISAAC KENDALL

DEPARTMENT OF RESEARCH BACTERIOLOGY, NORTHWESTERN UNIVERSITY MEDICAL SCHOOL, CHICAGO, ILLINOIS

THERE is a heterogenous group of formidable diseases of man and animals, including some of the most rapidly spreading infections, whose inciting agents have thus far eluded cultivation upon artificial mediums. There can be little doubt that the incitants of this group are living entities and their cultivation outside the body should, judging from past experience in bacteriology and preventive medicine, be helpful, not only in solving important problems of their life history, but also in approaching the solution of prophylactic and curative measures. A few of these "viruses" are said to have been kept alive for periods of time in presence of large amounts of blood, or pieces of tissue from recently killed animals, but by common consent, this limited, restricted development is not regarded as equivalent to cultivation in the usual bacteriological sense.

---

[1] The James A. Patten Lecture in Bacteriology, Northwestern University Medical School, Chicago, Illinois, July 22, 1931.

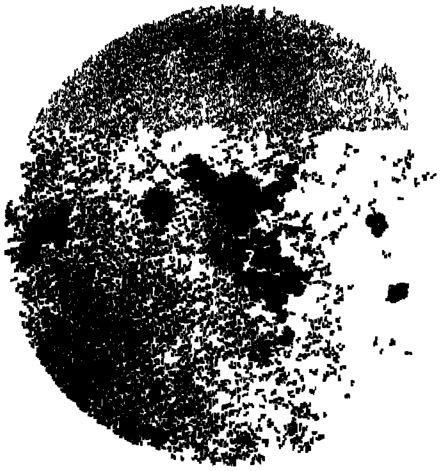


Fig I Diplococcus from a case of influenza, showing variation in size and intensity of staining

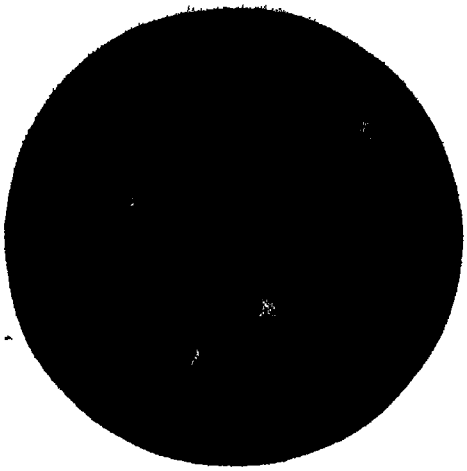


Fig II Diplococcus from a culture of influenza, 48 hour culture in K medium Dark field illumination, showing granules

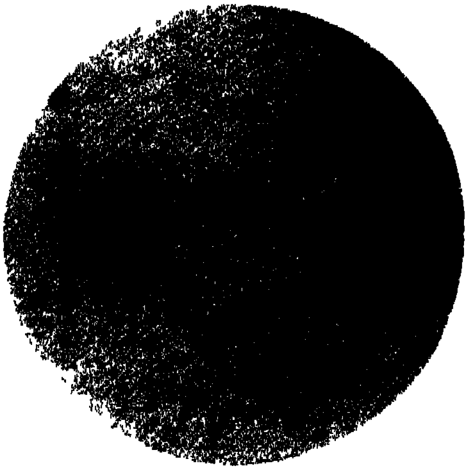


Fig III B typhosus, 24 hours' growth in K medium, showing granules, and faintly staining residuum of organism

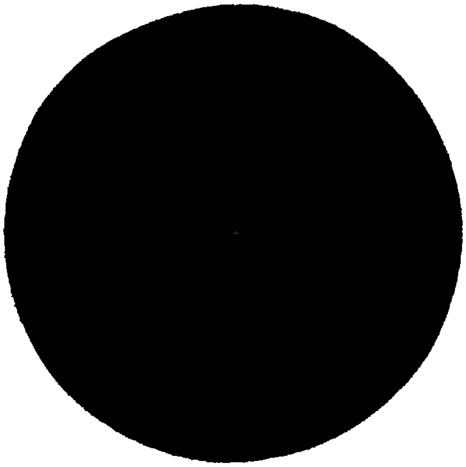


Fig IV B typhosus, 48 hour culture in K medium Dark field illumination, showing granules

One can not but be impressed, in attempting to analyze the uniform failure to induce growth of these "viruses" in artificial mediums, with the fact that artificial mediums at present available for their cultivation depart radically from the physical nature and chemical composition of their natural habitats Also, and this is significant, the more closely mediums approximating the nature and composition of living tissues are prepared, the more nearly has there been indication of at least some multiplication of these "viruses" outside the animal body Comparing the artificial medium with the natural environment of these "viruses," one is struck by two outstanding differences, omitting for the present the question of inorganic constituents The artificial medium contains protein degradation products, peptones and meat extractives, and little or no unaltered, or nearly unaltered, protein The tissues of the body, on the contrary, contain unaltered protein, and little or no peptone or other protein degradation products, and there is clearly a difference as well as a distinction between limited life in fresh tissue or blood, on the one hand, and on the other hand true passage with almost limitless capacity for multiplication through a series of artificial cultivations By comparison, current knowledge of the nature of cultivable microbes, their morphology, physiology and chemistry, contrasts strikingly with the paucity of information concerning the so-called "virus" diseases, of which but little is known, except objectively. And yet in this virus group are smallpox, vaccinia, measles, rabies, that extraordinarily contagious group comprising influenza, common cold and its clinical variants, poliomyelitis, encephalitis and several others.

A theoretical method of approach to the problem of cultivation of these refractory "viruses," therefore, would appear to be the preparation of a sterilizable medium containing unaltered, or nearly unaltered, protein, and without peptone or significant amounts of other nitrogenous constituents, to confine discussion for the present to these most significant substances.

Such a medium has been prepared.[2] In brief, the essential ingredient is small intestine of man, swine, dog or rabbit, whichever is available, thoroughly extracted with alcohol to remove water and alcohol soluble extractives, followed by extraction with benzol to remove excess of lipoidal substances. This residue, dried, can be kept indefinitely. The addition of Tyrode solution, or even normal saline to this powdered extracted substance, makes a rather turbid medium which can be autoclaved without apparent harm. The autoclaved medium (referred to hereafter for brevity as the K medium) possesses most unusual qualities. These may best be expressed by citation of a series of experiments with it.

Fresh, aseptically drawn blood from seven cases diagnosed as mild influenza, four from cases in Passavant Hospital, three from cases in Evanston Hospital, was added to K medium, previously heated, then rapidly cooled to expel air, in the proportions of 10 cc of blood to 90 cc of medium. Incubation was practiced for several days at 30 degrees C. Three cultures showed increasing cloudiness with the progress of incubation; four did not. From the three cloudy cultures, an organism was isolated. The four remaining bloods continued sterile for nine weeks. Then they were discarded. Attention is drawn in passing to the difficulty in establishing a definite clinical diagnosis of influenza in these milder, sporadic cases, which occur in inter-epidemic periods. It is not without significance, therefore, that the three positive cases discussed here were found in two entirely separate institutions, and the diagnoses were made absolutely independently by physicians living in Chicago and Evanston, respectively.

Inasmuch as there has been, very properly, much just scepticism about the cultivation of filterable organisms in general, the details, including dates, of the two positive cultures from the Passavant cases are reported here at considerable length.

Isolation of Filterable Organisms from Cases of Influenza

Eight rabbits were put in stock under observation January 2, 1931. No spontaneous illness developed during the course of the experiments that followed.

A. February 3, 1931. 10 cc of blood from cases No. 3 and No. 4 (Passavant), respectively, were added to 90 cc of K medium.[3] Incubation was practiced for 10 days at 30 degrees, during which time distinct cloudiness developed. (Cultures No. 3A and No. 4A.)

B. February 13, 1931. Seven loopfuls of culture from No. 3A and No. 4A, respectively, were added to 10 cc of the K medium. They were incubated at 30 degrees for 10 days. The mediums became progressively clouded. (Cultures No. 3B and No. 4B.)

C. February 23, 1931. Seven loopfuls of culture from No. 3B and No. 4B, respectively, were added to 10 cc of the K medium. Incubated at 30 degrees for 10 days. The mediums again became clouded. (Cultures No. 3C and No. 4C.)

D. March 5, 1931. Seven loopfuls of culture from No. 3C and No. 4C, respectively, were added to 10 cc of the K medium. Incubated 5 days at 30 degrees. Considerable cloudiness developed. (Cultures No. 3D and No. 4D.)

E. March 10, 1931. One half cc of cultures No. 3D and No. 4D, respectively, was injected into the ear vein of rabbits No. 3 and No. 4. At the same time, as control, 1 cc of the medium from each of three negative flasks of K medium (from cases No. 1, No. 2 and No. 5), was injected into each of three rabbits. These control rabbits remained normal.

Ea. March 11, 1931. Rabbits No. 3 and No. 4 sneezed paroxysmally, and frequently during this day and for the next four following days, with apparently unabated violence. Rectal temperatures for March 11 (24 hours after inoculation) and for March 18 (one week later), were as follows:

	Temperature March 11	Temperature March 18
No. 1 (control rabbit)	102.2	102.0
No. 2 (control rabbit)	102.1	102.0
No. 3 ("flu" rabbit)	103.4	102.8
No. 4 ("flu" rabbit)	104.0	102.5
No. 5 (control rabbit)	102.4	102.2

By the sixth day, the acuteness of the sneezing had abated. Rabbit No. 4 made an uneventful but rather slow recovery, rabbit No. 3 still sneezes paroxysmally (June 23) and appears to be slowly losing ground.

F. March 12, 1931. 12 cc of blood was drawn from rabbits No. 3 and No. 4, respectively; it was distributed as follows:

1 cc to 10 cc of K medium = cultures No. 3Fa and No. 4Fa
1 cc to 10 cc of dextrose broth = cultures No. 3Fb and No. 4Fb
10 cc to ice box for 24 hours = blood, No. 3Fc and No. 4Fc

Cultures No. 3Fa and No. 4Fa, after 10 days' growth at 30 degrees were plated on agar containing both dried intestine and proteose peptone.[4] Three days' anaerobic incubation followed by four days' aerobic incubation at

---

[2] The details of preparation will appear in another communication.

[3] K medium heated, and cooled rapidly each time to remove air.

[4] Proteose peptone, extracted thoroughly with absolute ethyl alcohol; meat infusion peptone agar is equally satisfactory, as was found out later.

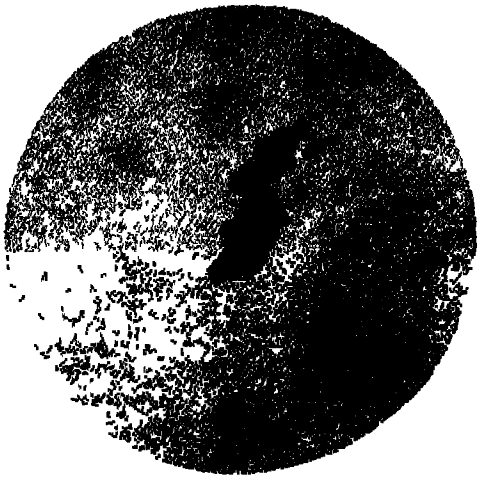


FIG V. Staphylococcus from Staphylococcus bacteriophage. First culture on agar after K medium. Irregularities in size and staining are noticeable.

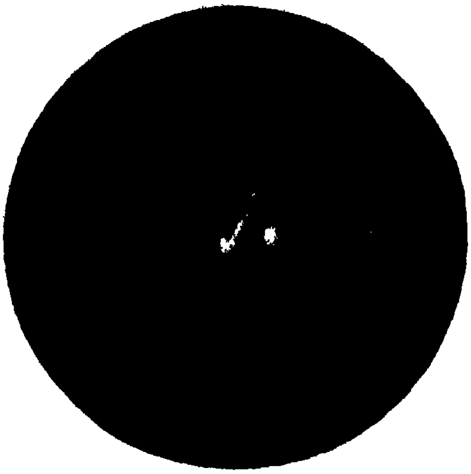


FIG VI. Leptospira icteroides, second transfer in K medium. Beginning of granulation. Dark field illumination.

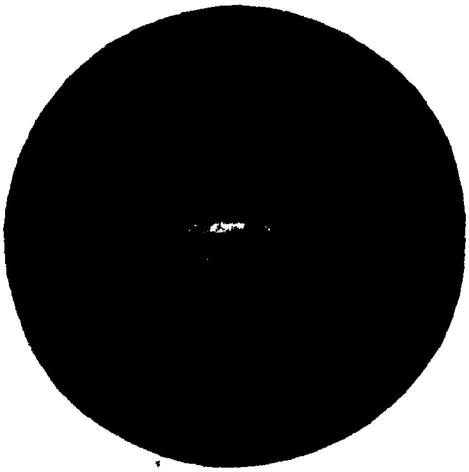


FIG VII. Leptospira icteroides. Two weeks in K medium. Granulation complete. Organism filterable. Dark field illumination.

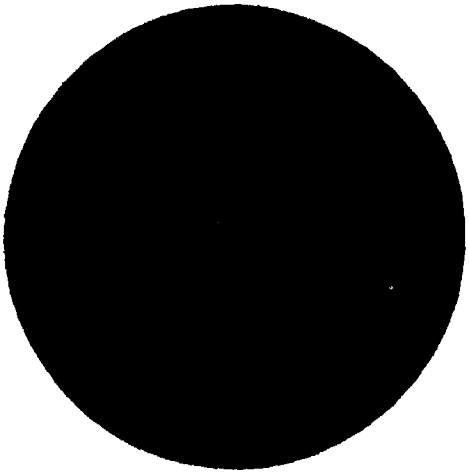


FIG VIII. Leptospira icteroides. Growth in peptone-blood serum agar after filtration through Berkefeld N filter. Dark field illumination.

30 degrees, was productive of many small, almost invisible dew drop colonies. After transfer to blood agar (sheep), they grew as moist, fairly luxuriant white streaks. The organisms, which are members of the coccal group, appear to be somewhat pleomorphic, particularly in the first growth upon solid mediums. They tend to occur in pairs, they ferment the ordinary sugars, they are non-proteolytic, and stain with ordinary anilin dyes. They have little, if any, digestive action upon sheep hemoglobin.

Cultures No 3Fb and No 4Fb (in dextrose broth) remained absolutely sterile for several weeks. The coccus in the filterable state does not appear to grow in ordinary mediums, even when enriched with blood.

G. March 13, 1931. Serums from bloods No 3Fc and No 4Fc were filtered through Berkefeld N filters, after dilution to seven times their respective volumes with sterile physiological saline solution. One fourth cc of each serum Berkefeld filtrate was added to 10 cc of the K medium, and after incubation for 10 days at 30 degrees, was plated on the intestine peptone agar. Colonies identical with those from cultures No 3Fa and No 4Fa were obtained after anaerobic incubation (3 days) followed by aerobic incubation (4 days).

Also, 5 cc of each of cultures No 3D and No 4D (the remainder after rabbit injections), diluted with three times their volume of sterile saline, were filtered through Berkefeld N filters. The filtrates, treated in precisely the same manner as filtrates No 3Fc and No 4Fc, yielded colonies which were morphologically and culturally like those had from No 3Fa, No 4Fa, No 3Fc and No. 4Fc. Also, similar organisms were isolated, but more slowly, from blood No 6 (Evanston Hospital case).

A brief recapitulation of these observations will indicate the several unusual features they present.

1 The seven influenza cases were quite similar clinically Blood cultures made from four were sterile, even after prolonged incubation in the K medium Three blood cultures yielded apparently identical organisms This would seem to indicate that these organisms were not adventitious The possibility of contamination at the time of taking the bloods is recognized, but from the nature of the organisms isolated, it is deemed rather remote, especially in light of the fact that the patients showing positive blood cultures were in two different hospitals The four negative bloods also, from two separate hospitals, are an additional control on technique

2 The mediums used for cultivation were autoclaved at fifteen pounds steam pressure for twenty minutes Therefore, they were initially sterile

3 The rabbits, both those showing symptoms (No 3 and No 4) and those remaining well (No 1, No 2, No 5, No 7 and No 8), were under observation a full month before inoculation, and several weeks after inoculation No symptoms of snuffles or other disease appeared among the control animals during this time Three uninoculated rabbits (No 5, No 7 and No 8) of the control series were kept in cages adjacent to rabbits No 3 and No 4, which, it will be recalled, sneezed vigorously for several days They remained well Apparently the infection induced in these rabbits was not very contagious for other rabbits Blood from case No 6, which developed turbidity in K medium much more slowly than bloods No 3 and No 4, was not injected into a rabbit

4 The filters, Berkefeld N, failed to pass dextrose broth cultures of B. typhosus or the coccus above mentioned They passed the filterable stage of the coccus readily, however

Results

From two bloods, taken from patients presenting clinical symptoms reminiscent of influenza, organisms were isolated which induced paroxysms of violent sneezing in rabbits From the rabbit inocula, and from the blood of these rabbits, taken on the second day of infection, a filter passing "virus" was cultivated in the K medium From the K medium, after incubation and development, cocci were isolated These cocci, in their unfilterable state, could readily be retransformed to the filterable state upon K medium, refiltered, and recovered again, after a period of development in K medium, followed by growth on agar, as unfilterable cocci. It should be emphasized that the filterable state is readily induced by inoculation of the cocci in the special medium The converse process, transformation of the filterable to the non-filterable state, is a relatively slow procedure. It can be done, however, by inoculation of K medium growth upon intestine-proteose-peptone agar, possibly better upon blood agar and usually, except for very fastidious microbes, as will appear later, upon plain agar Colonies appear upon the solid mediums after a few days as tiny, clear, dew drop growths, which upon retransfer become heavier and more luxuriant. The coccus, therefore, can exist in a filterable state, in which condition it grows in the K medium, but does not appear to grow visibly in peptone mediums, and a non-filterable state, in which growth upon ordinary peptone-containing mediums is readily obtained The rabbit infections were induced while the coccus was apparently in the filterable state Attempts to induce infection with the non-filterable (coccus) state were unsuccessful Experiments are under way to determine the nature and extent of changes in the virulence and infectivity of this microbe

The relation of this coccus to the etiology of influenza naturally presents itself at this time While the evidence, so far as it has been revealed, certainly is suggestive that more than accidental parallelism exists between the filterable state of this coccus through the rabbit syndrome to the human infection, proof is, of course, wanting It can not be denied that possibly a filter-passing virus was simultaneously present This might conceivably have caused the rabbit infection, and also perhaps explain the non-contagiousness by droplet infection from rabbit to rabbit. If so, it must be admitted that such an hypothetical "virus" either developed well in the K medium or else it was present in great abundance in the original blood cultures, which gave positive growths in K medium, also, if such were the case, it was also absent in the negative bloods, unless, perchance, a symbiotic action between the hypothetical "virus" and the coccus herein described was taking place

It should be pointed out also that the dilution factor from the original blood (1 10) through cultures A–D inclusive in the K medium, would reduce the original constituents of the positive bloods many hundreds of times in the actual inocula of the rabbits The possibility of the persistence of such a "virus" is freely admitted, nevertheless

However, the most far-reaching phenomenon brought to light in this investigation is the obvious existence of the coccus isolated from these three cases of "flu" in two states, a filterable, and a non-filterable Insofar as these experiments indicate, furthermore, the distinction between the two states does not depend primarily upon the somewhat academic question of porosity of filters, but upon actual, consistent differences in nutritive environment. The filterable form does not appear to develop into visible forms in plain or dextrose broth (although occasionally they may develop upon agar under certain conditions), but it may be readily cultivated in the K medium On the other hand, the non-filterable form, the coccus, grows readily in ordinary mediums It changes rather readily *to the filterable form, however, in K medium*

Having shown that this coccus exists in a filterable and a non-filterable state, it is not unreasonable to suspect that other bacteria might exhibit this same phenomenon of dual existence if exposed to the same cultural conditions Such has proved to be the case

The belief that bacteria may have a filterable state is a very old one [5] In some instances, for example in the pus from cold abscesses, proof seems to have been procured It is well known that formed tubercle bacilli are not found in such material, although Much granules,[6] which Fontes[7] showed could be passed unharmed through Berkefeld filters, have long been known Not a few references to the successful passage of B coli, B dysenteriae (Shiga type), and B typhosus through stone filters have also appeared from time to time in the literature, but these observations have not been very generally accepted, apparently because the experiments have not been repeatable in seriatim On the other hand, there is a group of infections, incited by transmissible agents, capable of inducing pathological states in man, animals and plants, to which the term "filterable viruses" has been applied The inciting agents have not, in most instances, been cultivated in artificial mediums, and little is known of the properties of these agents aside from their contagiousness, and the pathology of the lesions they incite This embraces a large and important, but very heterogeneous group [8] Within it are some of the most formidable infections of man Some of the major problems in epidemiology, immunology and prevention and therapy are inextricably tied into this baffling group, whose members, resisting cultivation in ordinary mediums, have eluded science thus far

To make this part of the investigation brief, it may be stated that the first organism examined for a filterable state was a culture of B typhosus, which had been in stock in the laboratory for several years

It was put into the K medium, cultivated for 48 hours at 30 degrees, and after dilution with twice the volume of sterile physiological salt solution, was filtered through a new Berkefeld N filter. The clear Berkefeld filtrate was added to mediums in amounts as follows: 2 cc and 0.25 cc, respectively, to 10 cc of dextrose broth, 2 cc, 1 cc, 0 5 cc and 1 drop, respectively, to 10 cc of K medium

Incubation of these filtrates was practiced for 48 hours in the K medium The dextrose broth cultures remained sterile for three weeks. The 48-hour K cultures also failed to give cultures upon intestine proteose peptone agar plates, but after 72 hours' incubation, agar cultures made from them and kept in the incubator at 30 degrees for several days, yielded numerous colonies of B typhosus These were characteristic morphologically and in staining reaction Transfers of these colonies, introduced into either plain or glucose broth, agglutinated readily with specific typhoid serum

It appears, therefore, that B typhosus, as well as the coccus from the influenza cases, can be rendered filterable The filterable organisms fail to grow in ordinary broth mediums, but in the K medium, growth proceeds in due course, and eventually typical typhoid bacilli may be recovered in the manner indicated The details of control of filters and pertinent associated phenomena will appear in another communication

Other bacteria have been similarly made filterable, filtered and recovered. To date Rosenow's poliomyelitis streptococcus, Dochez's scarlet fever streptococcus, B paratyphosus alpha, Noguchi's Leptospira icteroides, as well as Staphylococcus aureus, B typhosus, *and the coccus from the "flu" cases*, have thus been put through their paces. It should be pointed out here, as will be explained in another communication, that not infrequently the first tiny dew drop colonies appearing on agar plates from the up growth of the filterable organisms, are very inert, both chemically and culturally One or *more* transfers in ordinary mediums may be required to elicit the usual luxuriance of growth and capacity for chemical activity

Next, it appeared that certain much discussed, not well understood phenomena, bacteriophage and antivirus, which conceivably might have a similar explanation, should be investigated. Details must be left to other communications which will follow shortly, but it may be stated here that both Staphylococcus "phage" filtrates, and Besredka "Staphylococcus antivirus" have each yielded perfectly typical cultures of Staphylococcus aureus upon cultivation in the proper manner. A sample of rabies vaccine from a lot that apparently caused a case of human encephalitis, was inoculated into the K medium. After a period of acclimatization and growth, transfer to agar plates yielded a coccus that is under investigation. In light of what has been said, it is significant that growths were not had even upon prolonged incubation in enriched peptone-containing mediums Positive blood cultures have been obtained, quite readily, from a series of cases of common cold, of arthritis, of rheumatic fever, and rheumatoid endocarditis, measles (30 hours before the appearance of the rash), and German measles. These failed under parallel conditions to yield cultures upon any artificial mediums. In one case of endocarditis, with fever, and a rather sudden increase in symptoms, an hemolytic streptococcus was isolated both directly upon blood agar (sheep) and coincidently from the K medium. It is perhaps significant that the isolation with the K medium in this instance, where the blood agar culture was positive, was completed in 72 hours. Usually thus far, when cultures in peptone mediums are negative, final isolation of the organisms from the K medium requires from 10 days to 2 or even 3 weeks. Here again, the details must be presented in another place. Enough has been related, however, to focus attention upon the apparently fundamental and general character of the phenomenon which has been described, namely, that bacteria representative of many of the important divisions of this great group of organisms can, and apparently do, exist in two distinct states. One, readily filterable through Berkefeld N filters, the other, not filterable, exhibiting characteristic morphology and staining, and with appropriate organisms, immunological reactions, each distinctive after its kind. It is perhaps unnecessary to repeat and to reemphasize here, that the multitude of details surrounding each organism necessitates separate consideration of them individually. These will appear at the proper time.

---

[5] An excellent summary by Klieneberger· "Bakterienpleomorphismus und Bakterienentwicklungsgänge," *Erg d. Hyg , Bakt Immunitätsforsch u Exp Therapie*, Berlin, 11 499–555, 1920, has the important details and literature.

[6] H Much, *Beitr. z. Klin d. Tuberk*, 8 85, 1907

[7] A. Fontes, *Centralb f Bakteriol.*, Abt I Ref, 51. 244, 1912.

[8] See T M. Rivers, "Filterable Viruses," *J Bacteriology*, 14: 217–257, 1927, for excellent summary

Nothing has been said thus far about the morphology of bacteria in the filterable state. It is possible to see changes which appear to lead to the filterable state by inoculating, for example, B. typhosus, into the K medium. Better and clearer preparations can be had in a "clear" K medium which can be prepared from the original medium, as will be shown elsewhere. After 15 to 18 hours' incubation in this medium, many of the typhoid bacilli, seen under the dark field, lose their homogeneity and appear first as faintly discernible shadows, having the bacillary outline, without, however, their luminous substance. They are actively motile at this time. Several brilliantly luminous, but small granules, from two to four or more, appear within the shadowy outlined organisms. The addition of specific typhoid serum to such cultivations causes agglutination, but the time required is decidedly longer than that necessary to elicit agglutination in parallel peptone broth cultures, which contain only typical bacilli. Upon retransfer and reincubation in the K medium, the bacillary forms become much smaller, and eventually for the most part are lost. Methylene blue stains made at this stage frequently reveal a multitude of very small, faintly blue staining rod-shaped bodies, enclosing more deeply stained slightly reddish granules. These shadowy bluish haloes encircling the more deeply staining central parts are reminiscent of the Rickettsia bodies, found in lice. It should be stated here, that a culture of Proteus, X19, obtained from a case of typhus several years ago, presents a very similar appearance, when cultivated in the same manner.

Finally, the bacillary part of the organism disappears, and there remain merely the very small granules, appearing under the dark field as intensely bright, yellow oval bodies. Of course the dark field furnishes no index of the true size of these granules, and but little idea of their shape. In this state, the granular vestiges of the typhoid bacillus pass an N Berkefeld filter readily. It may be recovered in the bacillary state by appropriate recultivation, as explained previously. Staphylococci similarly become smaller, and colored with methylene blue appear as oval, faintly staining haloes surrounding a granule. Upon longer incubation the nebulous halo disappears, leaving granules, which under the dark field are quite similar to those of B. typhosus. Streptococci tend to retain their linear alignment through the nebulous state, but appear to lose it when the granules are finally left as vestiges of the original organisms. Usually a proportion of the bacilli or cocci remain unchanged during the earlier stages of the process, and cultures at this period can usually be had in ordinary mediums, presumably originating from these unaltered or partly unaltered forms. Filtration, however, appears to sift these out. They remain behind, and direct cultivation of the filtered granules into nonfilterable forms in ordinary plain or dextrose broth is almost always impossible. A few days' growth in the K medium, however, will almost always afford successful transit to the typical organisms. This inability of the filterable granules to develop in ordinarily favorable cultural mediums, such as plain or dextrose broth, seems to afford some evidence of the efficiency of the filters as restrainers of the normal bacillary or coccus forms of the organisms. It should be emphasized here that the mere fact that there is failure to elicit growth of the filterable forms of these bacteria in ordinary peptone-containing media is not proof they are not viable. A *small* amount of broth containing these granules, added to the K medium, will usually result in growth, even though a week or even two weeks elapses from the time of filtration to the date of recultivation. Much longer periods of survival of these granules are met with. Upon two occasions, perfectly typical strains of Staphylococcus aureus were cultivated from Staphylococcus phage which was 10 months old. Cultivation in nutrient broth of the same composition as the phage solution itself, however, was always negative. It is of some importance to note that the coccus which was isolated from the blood of case No. 3 on February 3 was re-isolated as late as June 12. The flask containing the blood had been in the ice box for about three months. A few loopfuls were placed in K medium, and after two weeks at 30 degrees, colonies were obtained upon transfer to agar plates. Inoculations at the time into ordinary mediums were negative. Apparently the protein ingredients of the extracted intestine, which are lacking in the peptone medium in which these filterable forms exist, furnish the conditions essential for growth of the granules which seem to constitute the non-filterable state of the organism. Whether there is, or may be, multiplication of these filterable granules in phage, Besredka "antivirus" or in peptone solutions, can not be answered definitely at this time.

One rather unexpected phenomenon intruded itself during these filtration experiments, for which no explanation can at present be given. It seems to be quite in opposition to what common sense would predicate. Filtration experiments were conducted in general in accordance with this routine: the growth in the K medium, after proper development, was diluted with twice its volume of sterile, physiological saline solution, and filtered with very little vacuum, usually less than four inches below normal atmospheric pressure as measured by a vacuum gauge. The water-clear filtrate (which always showed granules, both of media, and organisms under the dark field), was distributed as follows: to dextrose or plain broth 2 cc and 0.25 cc respectively in 10 cc of medium. To the K medium, 2 cc, 1 cc, 0.5 cc, 0.25 cc and 1 drop respectively to 10 cc. Almost always, but not invariably, the tubes receiving 0.25 cc and 1 drop of filtrate from the K medium showed more rapid and better growth than those corresponding cultures containing the larger amounts of inocula from K medium. In no case thus far has growth ever been detected in the ordinary broth cultures, although sub-cultures of a few loopfuls of broth to K medium usually afforded growth eventually. This strange phenomenon has been noted so often and so consistently, it seems to be more than a coincidence. On the other hand, it seems to violate the law of diminishing returns. As an oft-repeated happening, it is proffered for what it is worth.

It is pertinent to inject here a few observations drawn from the field of bacteriology, which may have significance in light of what has been related.

Several types of infection are known in which organisms, at first demonstrable, disappear, even though symptomatology persists. Thus, in syphilis, the Treponema are clearly demonstrable in mucous patches, and in the initial lesion by dark field illumination. The organisms are rarely found in the spinal fluid in later stages, although reports of the presence of "granular bodies" in material from the cerebrospinal axis are in the literature. The ovoid bodies found by Noguchi and Flexner, and cultivated by them from cases of poliomyelitis, especially in light of the filterable nature of the material from which they were isolated, is certainly equally suggestive that these bodies are more than mere débris of media, even though current texts appear to have abandoned belief in the etiological relationship of these ovoid bodies to disease. Thus far it has been impossible to obtain an authentic culture of these ovoid bodies for study. It is very important to recall that Rosenow has repeatedly injected his streptococcus, isolated from poliomyelitis cases, into animals with the elicitation of symptoms. In many instances, especially when the animals survive for a few days before examination, it has been found difficult to demonstrate the injected organisms by staining methods, or even by culture. Reference is made at this point to the filterability of his streptococcus, of which he very courteously sent cultures, described above. It is not at all impossible to believe that the Rosenow organisms injected in the non-filterable state gradually change to the filterable state in presence of the brain substance, as previously explained. If this be true, cultivations from such animals in a K medium (or if necessary with K medium modified by substituting brain for intestine) should be successful.

Granules from cold (tuberculous) abscesses, and the appearance of Rickettsia bodies, has already been commented upon, as has the Besredka Antivirus (staphylococcus) and Staphylococcus bacteriophage. Many lesions occur in the tissues of man and of animals, in which bacteria can not be demonstrated by staining methods, and from which bacteria may or may not be isolated. It is not improbable that in many instances the same type of phenomenon of filterable and non-filterable stages of bacteria is involved in these. A culture of Leptospira icteroides (Arias strain), obtained through the courtesy of Dr. Sawyer, likewise proved filterable, thus apparently confirming Noguchi's contention that his spiral organism had a filterable stage. Blood from cases of yellow fever has not been available, consequently the rather obvious attempt to cultivate a non-filterable organism from the filterable "virus" of yellow fever has of necessity been postponed.

Granted that many bacteria, and by implication, many "filterable viruses" do have a filterable, and a non-filterable stage, the question arises, what determines the one state or the other? While a final answer can not be given at this time, sufficient evidence has been gathered to formulate at least one procedure which has been uniformly successful in causing non-filterable forms of representative types of bacteria to become filterable, and after filtration, to be forced to pass back again into the non-filterable state The phenomenon indeed appears to be quite general among the types of bacteria

Thus far, emphasis has been laid upon the microbic side of this problem of bacterial filterability, and return to their non-filterable forms Some important correlative information may be gleaned from a brief discussion of the conditions bacteria meet in the body itself, especially in relation to infection. Generally speaking, microbic infection of the body may be considered as taking place when the prospective invading microbe passes across the barriers which usually suffice to keep it out, and actually penetrates the protein fastness itself A majority of bacteria, and probably a majority of "viruses" gain entrance through epithelia, principally those of the intestinal and respiratory tracts A remarkable chemical difference between these two tracts should be emphasized here The intestinal mucosa is almost constantly bathed in a medium rich in protein digestive products, which pass successively from highly complex peptones and albumoses to simple peptids and amino acids The latter, so it appears, are normally absorbed through the villi of the intestine, and pass to the blood stream Hence the mucosae of the intestinal tract are in a peptone environment, using the term "peptone" merely to indicate protein in various stages of digestion The nutritive value of this medium is reflected in the luxuriance of the intestinal flora The respiratory tract, and the oral cavity, on the other hand, especially the former, is by design a sterile tract Absence of protein degradation products, except at those times when purulence is present, is the usual state of affairs. Whether mucus is of significance in this connection can not be answered in light of current information Stated differently, the digestive tract is proteolytic, the respiratory tract is apparently aproteolytic. Bacteria that gain entrance to the digestive tract in the usual manner find abundance of protein derivatives for their nutrition, whereas bacteria that gain entrance to the respiratory tract do not normally find protein derivatives for their nutrition. Just what factors, singly and collectively, normally shield both these mucosae from bacterial invasion, are not well known, and for the moment they must be disregarded. The fact that deserves emphasis here is that bacteria within the intestinal canal are in an environment that should encourage their continued existence in the non-filterable state. Rather the contrary condition would appear to prevail in the respiratory tract Perhaps in light of this, it is not without significance that many, if not most of the contagious so-called "filterable viruses" appear to enter, and to leave, the body through the respiratory path. Few, if any, are suspected of entering or leaving the body through the intestinal tract.

An interesting parallel is found in the observations presented above, namely, that the filterable state of bacteria can apparently be induced by cultivating them in the K medium, which by design is rich in substance approaching tissue protein in composition, and free from peptones and most alcohol soluble nitrogenous extractives Bacteria that pass from the respiratory tube actually into the tissue of the lung, whether they are filterable or not as they enter the respiratory tract, become confronted with a protein-rich peptone-poor medium From what has been stated, this is one condition which tends to induce and perpetuate the filterable state Similarly, upon passing back from the lung tissue to the respiratory tube, the same condition prevails, unless there is purulence, which, as is well known, is associated with protein digestion Therefore, filterable states of bacteria should theoretically be not uncommon in infections of the respiratory tract, in absence, of course, of pus formation Perhaps it is unnecessary to reiterate that many, if not most of the "filterable viruses" are found in association with the respiratory, rather than the intestinal tract Bacteria leaving the body through the intestinal tract are exposed to nutritive conditions conducive to the non-filterable, rather than the filterable state. Such appears to be the case in light of current information This is not the whole story, however The fact that bacteria may pass readily into the filterable state does not explain just why bacteria, even in this state, can induce infection. Colon bacilli and typhoid bacilli, as has been shown above, are readily filterable, when grown in presence of protein and absence of peptone, but colon bacilli do not, except relatively rarely, invade the body The nature of the weapons with which certain kinds of bacteria force entrance through intact epithelia, which ordinarily suffice to keep microbes out, is still to be determined

Not enough work has been done to date to be dogmatic, but sufficient experimental evidence has accumulated to show quite clearly that the bacteria studied can be made to pass rapidly and readily to the filterable state by cultivation in the K (protein) medium, and what is perhaps equally significant, the converse is true, because several successful cultivations of bacteria of various types have been made from the blood stream in cases of influenza, common cold, arthritis, rheumatic fever, measles, and other pathological states, where bacteria have for a long time been confidently expected to exist, but from which cultivations in artificial mediums thus far have been rather regularly negative Applying the same reasoning with experience gained with this K (protein) medium to infections in the body, it seems not unreasonable to believe that as soon as bacteria as they are known in culture (the non-filterable state) pass into the tissues through the barriers that ordinarily suffice to keep them from the tissues, they are in a protein environment, which is free, or nearly so, from peptones and similar products of protein disintegration Under these conditions, bacteria may be expected to change from the non-filterable to the filterable state In this state their migration from place to place might reasonably be facilitated, and what is equally significant, their existence in the granular or a filterable state would probably explain why it is that bacteria as such are so infrequently demonstrable by stain or by culture in the body tissues except where pus collects Pus is rich in degraded protein. Possibly an interesting exception may be leprosy, where, as is well known, large numbers of stainable bacilli may be found in nodules devoid of evidence of local proteolysis In arthritis, and many other long drawn out microbic processes, culture and stain alike have usually failed to furnish unequivocal evidence of the presence of microbes, yet in the few cases studied in this series, using a medium adapted to the growth of these filterable forms, bacteria have been grown, where in the past sterility has been the rule It should be emphasized that even in these cases, referred to above, cultivations in the ordinary mediums, even enriched with blood, have usually been wholly in vain The objection may well be raised that the successful cultivation of organisms from a very few such cases mentioned above is not necessarily an indication of etiological relationship Bacteria might be present more or less normally in the blood stream It may be remarked, parenthetically, that if such be the case, the fact is well worth further investigation Normal tissues from animals are notoriously bacteria infested In this connection also it may be pointed out that organisms have been cultivated from two breast carcinomas rich in lymphoid tissue, and one lymph gland adjacent to a rectal carcinoma In these it would appear reasonable to suspect however that the regional lymph glands have merely strained out the bacteria that happened to be brought to them from time to time Even tubercle bacilli have been found in lymph glands without evidence of infection[9] However, bloods taken from nine normal persons have been most carefully examined as controls upon this point. They were all free from cultivable bacteria.

The problem of immunity, in light of these observations, takes on a new aspect. On the one hand, the beneficial effects reported during the use of phage and Besredka Antivirus for therapeutic purposes would seem to be related, not to enzymes or toxins, but rather to the presence of viable, filterable stages of bacteria, although, of course, enzymic and toxic effects are not disproven by any means Experience with vaccine virus and rabies vaccine, on the other hand, shows very clearly the protective efficacy of living, but (thus far) uncultivable "viruses," whose virulence has been purposefully profoundly altered by growth in other animals for sufficient time to change the host infectiveness Suggestions of the mechanism of alterations in host infectibility seem to be foreshadowed in some of the filterable forms of bacteria studied in this series It has repeatedly been noted, for instance, that filterable typhoid bacilli, cultivated serially in K medium prepared from hog intestine, grow scantily and slowly for several transfers in corresponding K mediums prepared in the same manner from dog or rabbit intestine Later, when culture acclimatization has taken place, it is rather difficult to pass the cultures in the filterable state back to hog intestine medium again A more rapid procedure of adaptation is to start with the typical, non-filterable typhoid bacillus, and inoculate directly from ordinary mediums to hog, dog, or rabbit intestine mediums as desired This is perhaps a cultural analogue to the well-known passage of human smallpox virus through a series of heifers to the vaccine virus state, or the passage of dog rabies through rabbits to the virus fixé state However, it should also be noted that some bacteria which grow fairly readily in a hog intestine K medium grow badly, or even not at all in dog intestine, and vice versa.

The relation of the filterable forms of bacteria to phagocytosis, and to serologic immunity, have thus far not been studied at all A large amount of work will have to be done to cover the multitude of problems that immediately arise from this dual stage of microbic existence.

A word of caution must be interjected. It is absolutely necessary to be assured of sterile mediums. A double autoclaving has been found satisfactory for the K medium, but this can not be practiced with egg white It coagulates Egg white, filtered through Berkefeld W filters (after dilution with sterile physiological saline solution) is rarely sterile. Bacterial growth can usually be obtained from such egg white filtrates, although otherwise, fresh egg white filtered and diluted with Tyrode solution is a rather good medium for the elicitation of filterable forms of bacteria This is again evidence, it would seem, of the existence of filterable, viable forms of bacteria in purely protein solutions And not only must mediums for the cultivation of the filterable states of bacteria be sterile, material from the human or animal body, and even cultures of bacteria themselves, in light of what has been stated, must be thought of as having possibly two or more distinct organisms living side by side It has long been known, for example, that the virus of foot and mouth disease can be carried along with vaccine virus for considerable periods, and there is therefore the possibility that blood cultures may harbor more than one organism In the foot and mouth disease-vaccine association, and in the filterable virus group generally, the protein which is usually associated, either from the body or in the artificially enriched medium, might suffice to keep the viruses in the filterable state, in which instance their presence would be readily overlooked The details of recognition and separation of such complexes will naturally vary with individual cases

---

[9] See Trudeau and Krause *J Med Research*, 22: 277, 1910

Bacteria also may be similarly associated there is some evidence already indicating that a filterable state of one microbe may be actually carried along, unrecognized, with a stock culture of another microbe, especially if transfers are made upon plain, nutritive meat infusion agar One form may remain hidden, and entirely unsuspected until cultivation is practiced for a period of time in K medium Reestablishment of the non-filterable form may reveal two organisms, where only one was presumed to be present

Finally, a word about mediums It is very obvious that the K medium, even with its variants as suggested above, is by no means the best that may be concocted The same tissue from different animals affords, in specific instances, some differential advantages for specific cultivation of one or another microbe, therefore different mediums should be available. Reasoning from analogy, with some experimental evidence also, it would seem to be consistent to utilize homologous tissue from homologous species for difficult isolations. Also, within limits which vary with the type of microbe, there is advantage in training them to develop in alien host tissue protein for purposes of immunization and experimental infection

Summary and Conclusions

1 The isolation of a filter-passing diplococcus from the blood of certain cases of influenza by means of a special cultural medium is described The experimental effects of this organism, while in the filterable state, upon rabbits, is discussed

2 A procedure is formulated for inducing at will both a filterable and a non-filterable state in bacteria Mention is made of a series of experiments in which both the filterable and the non-filterable state has thus been induced in a series of well-known bacteria comprising a variety of types

3 It is postulated that a majority, if not all, known bacteria can and do exist in a filterable and in a non-filterable state

4 A preliminary report of the isolation of microbes in the blood, not only of cases of influenza, but also from common cold, rheumatic fever, arthritis, from Staphylococcus bacteriophage and Besredka's Staphylococcus Antivirus is presented in evidence of the ubiquity of the procedure

5 An explanation of the chemical basis for the existence of bacteria, both in the filterable and non-filterable states, in the animal and human body, and in culture, is proffered

6 The relation of this chemical concept to microbic infection, and the state of microbes in the body during infection is discussed

In conclusion, it is a privilege as well as a pleasure to inscribe here my appreciation for the courteous cooperation of Dean Irving S Cutter, Doctors Charles A Elliott, Paul Starr, James G Carr, Walter Nadler, Howard Alt and Herbert Barker, of the department of medicine, and to Northwestern University for the generous facilities and unrestricted opportunity for research which have contributed immeasurably to this investigation

ARREST OF GEOLOGIC, ARCHEOLOGIC AND PALEONTOLOGIC WORK IN CENTRAL ASIA

By President HENRY FAIRFIELD OSBORN

AMERICAN MUSEUM OF NATURAL HISTORY

A Peiping society originally known as the Cultural Society, but now more definitely organized as the Commission for the Preservation of Antiquities, on June 3, 1931, addressed the following letter to Dr Roy Chapman Andrews in reply to an application of May 5, 1931, for the continuation of the American Museum explorations and researches in Mongolia·

Sir

We beg leave to acknowledge the receipt day before yesterday of your note stating that members of your

> Museum desire to proceed to Mongolia next year to resume their work of geological research.
>
> In discussions held at meetings of the Committee, all present have considered that, since your expedition repeatedly declared, at the time when you demanded permission to proceed to Mongolia to carry on your work last year that the expedition was going to wind up its past work and would therefore discontinue its trips, and since the Chinese Government has now organized a Western Frontier Scientific Expedition to proceed to Mongolia, Kansu and Sinkiang to carry on various scientific researches itself, during the present period of time there of course exists no necessity for permitting members of your Museum to make further trips to carry on this work
>
> Should American scholars be willing to come to Peking to make scientific research into the geological materials concerning Mongolia to be obtained in future as a result of surveys by members of the Chinese expedition, the Chinese Government will certainly afford them all facilities in order to conform with the principles of non-discrimination between nationalities in respect of science

The restrictions imposed by this society have not been placed on American exploration alone, for somewhat similar actions have been taken against the Swedish Expedition in Chinese Turkestan under Sven Hedin and more recently against the French Trans-Asiatic Expedition under Dr Georges Haardt and P Teilhard de Chardin, distinguished paleontologist and geologist, and the British Expedition under Sir Aurel Stein This is in line with the now openly professed policy of the Peiping Commission to stop all foreign scientific work in China, no matter by what nationality They have driven the distinguished archeologist, Sir Aurel Stein, out of Chinese Turkestan, they made very severe conditions for Dr Sven Hedin on his last geographic expedition to Chinese Turkestan They are putting every obstacle in the way of the present Trans-Asiatic Citroen Expedition of the French, they now bring to a full stop the ten years' work of the Central Asiatic Expedition of the American Museum

In the meantime by articles in the Chinese newspapers this commission is giving out erroneous statements as to the work of these various foreign explorations, rousing a hostile attitude among the people and thereby cultivating among the Chinese the thought that all foreigners are enemies of their country, and it is surprising to find that the membership of this commission is not confined to Chinese who are ignorant of the friendly and sincere intentions of the United States towards the Chinese people and their institutions, but that it includes returned American students who should understand the American attitude toward China and be grateful for it

For three years past, namely, since August, 1928, when the Peiping Commission seized the Mongolian collections of the Central Asiatic Expedition at Kalgan the American Museum has been working through the Chinese Minister, Dr. C C Wu, through Secretary of State Stimson, through Assistant Secretary Nelson T Johnson, now Ambassador to China, and through the Chinese Government of Nanking to overcome the hostility of the Peiping Commission and set before the Chinese the true state of affairs, namely, that throughout its entire ten years of exploration in China and Mongolia, the American Museum of Natural History has been actuated only by the highest and most generous motives. Every stage of its procedure has been with the full knowledge of the Chinese Government at Nanking and Peiping and with the Mongol Government at Urga—not only with full knowledge but with full prior consent Moreover, it was agreed from the outset that the American Museum would leave entirely untouched the tempting fossil fields within the boundaries of China proper to the well-organized National Geological Survey of China, and that it would cooperate with the National Geological Survey of China in sending duplicates or replicas of fossils not only of Asiatic origin, but of American fossils cognate to those to be discovered in Central Asia. More than this, during President Osborn's visit to Peiping in the year 1923, he offered to establish a branch of the American Museum within one of the now vacant palaces of the Forbidden City, to send duplicates of all the zoological collections made in China and all the zoological and paleontological collections made in Mongolia. The then director of the Peiping Museum of Art, Dr. Kungpa King, took the deepest interest in this project and actually aided in the selection of one of the palace buildings suitable for the exhibition of natural history collections Long prior to this the American Museum issued a manifesto which was widely printed and circulated throughout northern China declaring its sympathy in the preservation of all archeological and prehistoric objects and its opposition to looting and destroying these precious records of the ancient history of China

The abrupt interruption of these friendly and most promising relations came with the seizure of the entire collections of the year 1928 by the organization then known as the Cultural Society. Long months of negotiation between the American Museum, Washington, Nanking and Peiping ensued, culminating in the final release of this collection of fossils obtained entirely within the borders of Mongolia and beyond the confines of China, and composed almost entirely of geological and paleontological objects In the year 1929 permission to reenter Mongolia was again refused by the Peiping Commission; in the year 1930 the permission was reluctantly granted on the understanding that the Central Asiatic Expeditions would terminate. This was followed by the discovery of entirely new fossil fields of Pliocene age to the east of the Kalgan Urga Trail; it was this discovery which led the American Museum to request a renewal for the present year 1931 and for the coming year 1932.

At this point a brief recital, by the leaders Andrews and Granger, of what has been accomplished by the American Museum may be given.

Dr. Roy Chapman Andrews has been unable to make arrangements with the Commission for the Preservation of Antiquities of Peking, China, for the continuation of explorations in the Gobi Desert by the Central Asiatic Expedition. For ten years this Expedition, under the auspices of the American Museum of Natural History, New York, has been making a general scientific survey of Mongolia, partly with the hope of finding the birthplace of the human race. Its researches have opened a new volume in the history of world life. It has spent half a million dollars in the country and has in every way conformed to local customs and restrictions. When its work was first started in 1921 it entered into an agreement with the National Geological Survey of China in which it was expressly stated that the Expedition was free to work in Mongolia. The terms of this agreement have been scrupulously kept by the Expedition.

The Central Asiatic Expedition was organized in 1920 and the advance guard (Messrs. Andrews, Granger and Pope) reached Peking and established headquarters there early in 1921. Since then the Expedition has made five summer explorations in the Gobi Desert (1922, 1923, 1925, 1928 and 1930). The only paleontological work done outside of Mongolia was three winters' work (1921–1922, 1922–1923 and 1925–1926) by Mr. Granger, at Wanhsien, a locality which was turned over to the Central Asiatic Expedition by the Geological Survey of China because they could not, on account of disturbed political conditions, investigate it themselves. The only archeological work done by the Expedition outside Mongolia has been an investigation by Dr. Nelson (1925–1926 and 1926–1927) of the Neolithic Culture found along the banks of the upper Yangtse River.

In 1928 our Expedition went to Mongolia under permission obtained for us by the American Minister from Chang-Tso Lin, who was then in command of Peking. Our first contact with the Cultural Society came in the autumn of that year when we attempted to bring back to Peking our season's collection. The transport of our cases was blocked at Kalgan and it required two months of negotiations and the payment of a ransom collection of American fossils to finally get them free. In 1929 the Expedition was prevented from taking the field because of our inability to meet the demands of the Society. In 1930 these demands were modified to such an extent that the Expedition found it possible to accept them and our fifth Gobi exploration was carried out. It was agreed that year that this would be our last expedition but because of the important Pliocene deposits discovered in the Eastern Gobi it was desired to continue for one or two years more in the hope of achieving the chief aim of the Expedition, *i.e.*, the discovery of remains of ancient man.

Points to be emphasized are the following:

(1) Not a single specimen of any historical or archeological value, aside from Neolithic flints, has ever been taken from China or Mongolia by the Expedition, and these flints are still to be found strewn over the surface of the Gobi in millions.

(2) The great majority of fossils obtained have come from Outer Mongolia—a territory over which China relinquished the last vestige of control before our first trip there in 1922.

(3) It was arranged at the beginning of the Expedition that duplicates of all fossils would be returned to the Chinese Geological Survey. This arrangement has been lived up to and already the Survey Museum has been much enriched by duplicate specimens thus returned, and eventually there will be in China a very adequate representation of the collections made by the Expedition in Mongolia. Also, examples of all types of Neolithic flints have been given to the Survey Museum by Nelson.

(4) The Central Asiatic Expedition has always paid its way—spending a very considerable sum of money in China, also it has always worked openly, putting its cards on the table before each trip and at the close of the season announcing in public meetings in Peking (called usually by the Paleontological Society of China and held in the Survey Library), and in the press, the full results of the season's work.

(5) Those of us who have been associated with this Expedition can not help but feel that the presence of the Central Asiatic Expedition in China, with its personnel of talented men, has been an inspiration to Chinese scientists, and that the Expedition has been an incentive to the Chinese to do something for themselves along the same lines. In other words, we feel that our presence in China has been a benefit rather than a detriment to the country as a whole.

(6) The Expedition has not looted! It went into China in 1921 with the approval and cordial assistance of the Chinese scientists in Peking and their cordiality continued until 1927 when the self constituted body, calling itself the Cultural Society, came on the scene and proceeded, by false representations, to turn the public against us and eventually the scientists of China, in self-defense, have had to follow suit.

The principal discoveries of the Central Asiatic Expedition are as follows:

(1) The discovery in 1922, and the development (1922–1930) of one of the world's great fossil fields, with no less than twelve distinct faunas—Lower Cretaceous to Pleistocene.

(2) The discovery of dinosaur egg nests, and of the complete skeletons and remarkable growth series of skulls of the animals which laid the eggs.

(3) Discovery of Cretaceous mammal skulls and associated parts of skeletons. The only Mesozoic mammal skulls known except *Tritylodon* from South Africa.

(4) Much additional information regarding *Baluchitherium*, the world's largest land mammal

(5) Discovery of *Embolotherium*, a new phylum of Titanotheres and the most unusual and distinctive animal discovered by the Central Asiatic Expedition The extraordinary development of the nasals in this creature is unparalleled in modern or extinct forms

(6) Discovery of new phyla of Amblypoda and the extension of this order to mid-Oligocene time

(7) Discovery of a great deposit of the shovel tusk Mastodon, *Platybelodon*, with a remarkable series of specimens showing growth stages from foetal young to old age

CONCLUSIONS

The arrest of British, French, Swedish and American paleontologic and archeologic work in Central Asia constitutes a very serious setback to the cause of science and of civilization The matter would not be so serious if there were any possibility or prospect of the present ability of the Chinese to carry out this work themselves They have neither the scholarship nor the financial means of doing so beyond the confines of old China. The American Museum geologic, paleontologic and stratigraphic and topographic work in Mongolia and the great publications issuing therefrom have been possible only because the party was composed of a body of field experts such as has never been brought together before in the history of these branches of science, under a leader who has shown unprecedented ability to organize a series of expeditions into an absolutely unknown desert where all previous explorers had failed either to make discoveries or obtain substantial results

Our first knowledge of the paleontology of China came from fossils purchased in apothecary shops, for hundreds, perhaps thousands, of years fossils have been collected in various parts of China and ground up as medicine under the belief that they represent the remains of dragons The American Museum expeditions have been among the first to dispel this nation-wide superstition, and American institutions of medicine have been advancing the true art of medicine throughout China It is these very fossils, valueless in themselves, priceless in the knowledge they yield of the past history of the earth, the collection of which the Peiping Commission is now arresting

The friendly effort of the American Museum to train up a body of young Chinese who would establish the extremely difficult sciences of field geology, vertebrate paleontology and prehistoric archeology under the auspices of the proposed Natural History Museum of Peiping has been brought to a full stop by the ignorance and anti-American prejudice of the Society for the Preservation of Antiquities

This arrest of Central Asiatic exploration and research will cause world-wide disappointment and regret, especially among those who have been sincerely desirous of soundly establishing these great branches of science in China The Commission for the Preservation of Antiquities must, therefore, bear a heavy weight of responsibility for the retardation and finally for the arrest of scientific researches and explorations in Central Asia, whereby China is placed in the column of backward, reactionary and non-progressive nations

OBITUARY

ALDRED SCOTT WARTHIN

ALDRED SCOTT WARTHIN, student of disease, came into medicine by way of music An artist he remained throughout life in the intensity and the individuality of his impressions It was fitting that his first research should deal with the physiological effects of music and his last with the coming of death to the physician as depicted in art His work on morbid anatomy, clinical medicine and experimental pathology was done with a sensitive recognition of the actual, but from it he derived convictions that were passionately held

Born in Greensburg, Indiana, in 1866, Dr Warthin gained a teacher's diploma at the Cincinnati Conservatory of Music in 1887, an A B at the University of Indiana in 1888, and graduated in medicine at the University of Michigan in 1893, becoming doctor of philosophy by the way He was organist in churches to help himself through The next four years he spent in the study and teaching of internal medicine at Michigan, with some months in Vienna and Freiberg Then, turning his abilities to pathology, he became within six years Professor and Director of the Pathological Laboratory, taking his place amongst a brilliant faculty There he remained, happily striving with the opportunities created by his diverse talents even more than provided for them, until his death on May 23, 1931 In 1900 he married Katharine Angell, herself a physician He was made doctor of laws by the University of Indiana in 1928

Dr Warthin early decided that morbid anatomy was not the worked-out lode that many deemed it Nor was it for him. The material at his disposal then and for some years after was meager, but for this he more than compensated by an intensive scrutiny Rare was the post-mortem examination at that time to which he did not give three entire days. And overlooking nothing, finding a theme even in the pathology of the pacinian corpuscle, he became aware of the small signs of things that mattered largely.

This is most noteworthy in the long series of his discoveries with regard to lurking syphilis, but it is no less evident in the studies on the lymphoblastomatous conditions, on thymic hyperplasia and the status lymphaticus, on the changes produced by the Roentgen rays and on the significance of the hemolymph nodes, those little structures which had seemed so debatable until he proved them to be organs in their own right It was in relation to syphilis, though, that he rendered chief service as investigator By discriminating techniques and pertinacious observations he disclosed this disease in what had been taken always for innocent conditions, proving that it still tricks the doctor who for generations has been warned of its tricks

Contributions of other kinds he made in great variety and number A forceful, interested teacher whose influence continually ramified during forty years, Dr Warthin met country-wide demands for lectures He wrote text-books and comprehensive articles, labored as editor, served on public health committees, assumed presidencies, gave himself in short to activities which he knew to be alien to his main purposes, but carried on because he felt their need In scientific meetings he spoke with a candor wholesome in this day when errors of fact during public discussions in the search for truth are too often condoned or reserved for hole-in-the-corner criticism He expected as much of his fellows and experienced some naive disappointments As a humanitarian he would have been too aware of the dark side of life for his own good or that of others had not the bright side affected him still more He could turn from a gruelling conference on venereal disease to his garden, or to music, to medical history, or merely to the consciousness of existing vigorously, in which he took great delight

Possessed of a singular gusto for life yet utilizing his strength for the comprehension of the morbid, Dr Warthin was drawn latterly to studies of the aging process and of some aspects of death itself His book, "Old Age, the Major Involution," deals with the physical changes which constitute senility It was characteristic of him that he spared no material detail yet had recourse in the end to the imagery of the Book of Ecclesiastes In the "Creed of a Biologist" he set forth the view, as had Condorcet in the imminence of death, that it should suffice for man to believe in the progress of his kind and to make efforts toward it

Dr Warthin's last book, "The Physician of the Dance of Death," is in its immediate aspects an analysis of manners During many years he had collected "Danses Macabres" in almost unrivaled variety, and the little volumes, peopled with the men and women of four centuries, all suddenly aware that they are to die, furnished material to his hand From amongst these he selected only the doctor, treating his theme in a matter-of-fact way like so much else that, thus handled, had yielded its secret The first copies of the new-printed book awaited signature when death came to him—unrecognized, after all, since he saw in angina pectoris only a familiar asthma

Peyton Rous

The Rockefeller Institute

MEMORIALS

The *British Medical Journal* states that a meeting of the Osler Club was held in London on July 12 to celebrate the eighty-second anniversary of Sir William Osler's birthday Dr William Stobie, Mayor of Oxford, delivered the fourth Oslerian oration Dr. A Salusbury MacNalty, of the Ministry of Health, proposed and Dr A P Cawadias seconded, a vote of thanks, and Sir Percival Hartley briefly spoke in the discussion Among those present were Sir D'Arcy Power, Dr J D Rolleston, Dr K R Hay, Professor D Fraser-Harris, and Mr Arnold M Muirhead, whose recent "Memoir" of Lady Osler was displayed among the exhibits

A bronze bust of the late Professor Clemens Pirquet was recently unveiled in the garden of the New General Hospital of Vienna, when addresses were delivered by Professors Argt, Hamburger and Noeggerath, and Miss Harriette Chick, of the Lister Institute

RECENT DEATHS

Dr. Richard Alexander Fullerton Penrose, Jr., until his retirement in 1911 professor of geology at the University of Chicago, died in Philadelphia on July 31, at the age of sixty-eight years

The Reverend John Bernard Goesse, S J, professor emeritus of geophysical observations at the Saint Louis University, died at Saint Louis, July 25, at the age of sixty-two years Father Goesse was the founder in 1908 and the first director of the Geophysical Observatory of Saint Louis University and took a prominent part in the organization of the first Jesuit Seismological Service in 1909, together with Father Odenbach, of Cleveland, and Father Tondorf, of Georgetown His early retirement had been due to prolonged ill health

Dr Errol Lionel Fox, professor of chemistry at Washington College, Chestertown, Maryland, died on July 17 in Munich, in his thirty-ninth year

Dr William C Hassler, who served for thirty years as public health officer of San Francisco, died on August 2 Dr Hassler was elected this year president of the American Public Health Association.

Dr. Edward L. Creeden, head of the Bureau of Preventable Diseases of the New York City Department of Health and a member of the department for twenty-five years, died on July 31. He was fifty-five years old.

Professor Emil Warburg, eminent physicist, formerly president of the Federal Physical-Technical Institute and a member of the Prussian Academy of Sciences, died on August 1. He was eighty-five years old.

SCIENTIFIC EVENTS

THE JUBILEE MEETING OF THE BRITISH SOCIETY OF CHEMICAL INDUSTRY

The celebration of the jubilee of the Society of Chemical Industry, held in London during the second week in July, is described in the London *Times*. It included a reception at Guildhall by the Lord Mayor and Sheriffs, an address by the president, Sir Harry McGowan, at the Royal Academy of Music, and receptions by the Masters of the Girdlers' and the Salters' Companies. The presentation of the society's medal to Dr. Herbert Levinstein was made on July 15, and in the evening the annual dinner was held at which Prince George was the principal guest. The following day was devoted to the discussion of technical papers. There were visits to works and excursions in and near London.

The society was actually established in London, in the rooms of the Chemical Society early in April, 1881, with Professor (afterwards Sir Henry) Roscoe in the chair. Most of the forty-nine annual meetings have been held in various cities and towns in Great Britain, but three have been in New York and one in Montreal. Similarly, many active local sections have been formed, not only in England but also in Canada, Australia and the United States. The society, which received a Royal Charter in 1907, has now over 7,000 members.

As a small token of its admiration for work, the society presented a brief address to a few of the companies which had been most prominent in their support of technical and scientific education, and to a few whose work had been specially directed to those branches of education in which the chemical industry was specially interested. Plaques were also presented to many original members of the society and to a number of past presidents.

Throughout the week an exhibition of chemical plant, arranged by the British Chemical Plant Manufacturer's Association and the Chemical Engineering Group of the society, was open at the Central Hall, Westminster. The association was formed in 1920 to further the production and use of chemical plant made in this country. Over 50 British firms have cooperated to display the range and variety of chemical apparatus which their works can turn out. Where possible the actual plant was on view, sometimes in operation, but apparatus too large for exhibition was illustrated by models or photographs. In some cases cinematograph films were used to show processes of manufacture.

To illustrate the application of chemical processes to manufacturing industries generally would, however, have required very much more space than was available, and therefore chemical plant in the narrower sense bulked most largely in the exhibition. There are many exhibits of acid-resisting stoneware, porcelain, fused quartz and protective linings of various kinds as well as of the resistant alloys of steel and aluminium which have been developed of recent years, of nickel, and even of silver, which at present prices is becoming a possible material for some purposes. The exhibits also included pumps, filters, centrifugal separators, drying machines, thermometers, and other measuring instruments, and the absorbent substance, silica gel, which contains such large numbers of minute pores that a cubic inch has been calculated to possess an internal surface of over an acre.

A separate section of the exhibition, organized by the Chemical Engineering Group of the Society of Chemical Industry with the assistance of the Department of Scientific and Industrial Research and the Research Associations of various industries was designed to illustrate the application of scientific research to industry. It included materials used in chemical engineering, such as metals, fabrics, rubber, leather and paints, chemical plant, especially that applicable to fuel, and methods of testing and standardizing apparatus and materials.

THE BUCKSTON BROWNE SURGICAL RESEARCH FARM

The foundation stone of the Buckston Browne Surgical Research Farm at Down, near Farnborough, Kent, was laid by Lord Moynihan, president of the Royal College of Surgeons of England, on July 8. The site is one of thirteen acres, adjoining Down House, Charles Darwin's old home, which, with its grounds of twenty-three acres, was presented by Mr. Buckston Browne to the British Association for the Advancement of Science.

According to the *British Medical Journal*, the stone which has been laid will form part of the porch of the large residential building, in the style of a Kentish farmhouse, which will house the research workers, as well as those in charge of the laboratories and the animals. The building of the animal houses and the experimental laboratories has not yet begun A brief service of dedication was held by the dean of Westminster, who, after Lord Moynihan had laid the stone in place, pronounced the words. "Here may knowledge be increased, study fostered, skill developed, to the prevention and relief of suffering, the service of our fellow men, and the good of the human race throughout the world."

Lord Moynihan made the principal address He said in part·

> The Council of the Royal College of Surgeons, which properly regards itself as the custodian of surgical advance in this country, has now recognized that for the further expansion of surgery there must be a correlation of the various results from methods of inquiry in three directions (1) clinical research carried out also in the wards and in the operation theaters of hospitals, (2) biological and pathological research carried out in hospitals and in special institutions, and (3) research upon animals In accordance with the council's will, laboratories have been built and old laboratories extended in our buildings in Lincoln's Inn Fields, there men have been set to work upon lines which they themselves desire, and there men have learned "the religion of research," and the high value of the experimental method in connection with the science and art of surgery Now, owing to the great beneficence of a fellow of our college, we are here laying to-day the foundation stone of an institute for experimental research, which will add the one remaining event required for the proper development of surgery in this country

At the conclusion of this address Mr Buckston Browne spoke briefly, calling attention to the "very interesting fact that they had been able to bring the great genius of John Hunter, who did so much for the alleviation of the suffering of the human body, alongside that great genius Charles Darwin, the emancipator—as I like to think of him—of the human mind. These two great men are brought together to-day on this really sacred spot in Kent."

After tea had been taken, the company made their way along the sand walk—Darwin's "thinking path"—to Down House, the property which was presented in 1927 by Mr. Buckston Browne to the British Association as a memorial of Charles Darwin, where they visited Darwin's study, kept as it was during his lifetime, with the little paraffin lamp on the table, and the dog (now a trophy of the art of the taxidermist) in its basket on the hearth.

THE SIXTH INTERNATIONAL CONGRESS OF GENETICS

The sixth International Congress of Genetics will meet in Ithaca, New York, from August 24 to 31, under the presidency of Dr. T H. Morgan, director of the William G Kerckhoff Laboratories of the Biological Sciences at the California Institute of Technology

The New York entertainment committee, of which Dr A F Blakeslee, of Cold Spring Harbor, is chairman, has completed a tentative program for the four days from August 20 to 23, intervening between the arrival of the *Pennland* and the departure of the delegates for Ithaca. The Eugenics Congress is in session in New York at this time and many of the delegates will desire to attend some of the sessions During their four-day stay foreign members of both congresses will be entertained at Columbia University, through the cooperation of the university and the Carnegie Endowment for International Peace Rooms will be provided in the Columbia dormitories, and breakfast will be served at the Faculty House

According to the tentative program the scientific laboratories of Columbia University will be visited on August 20, after which a luncheon will be given This will be followed by a sight-seeing trip around the city At 7 30 p m there will be a formal complimentary dinner During the time spent in New York there will be an excursion to Cold Spring Harbor to visit the Carnegie Station for Experimental Evolution and other scientific laboratories at Cold Spring Harbor, visits to the New York Botanical Garden, the Boyce Thompson Institute, the Cornell Medical School, the Rockefeller Institute and the Medical Center of Columbia University One evening will be devoted to the addresses and reception of the Eugenics Congress at the American Museum of Natural History

On August 23 there will be a trip to Princeton, members of the congress being the guests of the Walker-Gordon Laboratories. For those not taking the Princeton trip an opportunity will be given to visit the American Museum of Natural History, the Metropolitan Museum of Art, and other places of interest in the city, with guides for groups if desired. Dr Stockard has offered to guide a group to his dog farm near Peekskill and Dr. Davenport a group to the State Institution for Feeble Minded at Letchworth Village. Luncheon will be at the American Museum of Natural History and in the evening a smoker or informal reception will be given

Tentative arrangements have been completed at Ithaca for a comprehensive exhibit of genetic material. The Carnegie Corporation of New York has appropriated $5,000 for the general expenses of the congress. A grant of $2,000 has been made by the Carnegie Institution of Washington for the Genetics and Eugenics Congresses, the sum to be used primarily for the exhibit Of this grant the Genetics Congress received one half

It is planned to have an excursion to Niagara Falls during the Congress The cost of a round trip on a special train is about $3 00 per person An excursion is also planned during the congress to the New York Agricultural Experiment Station at Geneva (about 50 miles north of Ithaca) where there will be exhibits dealing with fruit genetics and fruit breeding Meetings of sections, interested in fruit work will be held at Geneva during this excursion

It is expected that after the congress members from abroad will wish to take short trips in order to gain some impression of the scenery, the colleges, universities, public institutions and agriculture of the parts of the United States which are easily reached from Ithaca. Arrangements for transportation and entertainment for two organized excursions will be made—one through southern New England, including visits to Harvard, Yale and other colleges, Woods Hole, and to farms and agricultural experiment stations, and one to Washington, including stops at other cities and universities *en route*. For those members who wish to take longer trips to the west and south the committee will be glad to provide information and help, but because of the greater time and expense involved, no organized excursions will be planned unless a large number of persons request it

SCIENTIFIC NOTES AND NEWS

MME MARIE CURIE received the gold medal and honorary fellowship of the American College of Radiology at a luncheon given in her honor at the third International Congress of Radiology, which opened at the Sorbonne, Paris, on July 26 The presentation was made by Dr Albert Soiland, of Los Angeles

DR. CHARLES L PARSONS, of Washington, D C, long secretary of the American Chemical Society, has been elected to honorary membership in the Society of Chemical Industry, the insignia of this distinction having been presented by Prince George at the jubilee meeting of the society in London Chemists of other countries who were made honorary members are H W Matheson, Canada, Georges Patart, France, S P L Sorensen, Denmark, Heinrich Schicht, Czechoslovakia, Fritz Haber, Germany, Mario G Levi, Italy, Toyokichi Takamatsu, Japan, A M Llopis, Spain, and G Engi, Switzerland

DR ARISTIDES AGRAMONTE, of New Orleans, has been elected president of the fourth Pan-American Medical Congress to be held next year in New Orleans Vice-presidents elected are Dr Hugh S Cumming, Surgeon-General, Washington, D C, Dr Charles Mayo, of Rochester, Minn, Dr. J G W. Greef, of New York, Dr John M McReynolds, of Dallas, Dr L H Bauer, of New York, Dr Charles Snyder, of Miami, Dr Rafael Silva, of Mexico City, Dr Nicholas A Solano, of Panama, Dr Luis Bazetti, of Venezuela, Dr Fernando Rensoli, of Cuba, Dr Carlos Paz Soldan, of Peru, Dr Victoriano Rodriguez Barahona, of Cuba, Dr. Ulysses Valdez, of Mexico City, and Dr Horacio Ferrer, of Cuba

DR. JAMES R ANGELL, president of Yale University, will receive the degree of D Litt. from the University of Liverpool in December The degree of D Eng will be conferred on Dr H Hele-Shaw, emeritus professor of engineering at the University of Liverpool

THE Remington Medal of the Philadelphia College of Pharmacy and Science has been awarded to Ernest F Cook by the New York branch of the American Pharmaceutical Association The medal is awarded annually to the person "who has done the most for American pharmacy during the preceding year, or during a longer period of outstanding activity and of fruitful achievement" The presentation will be made next fall

DR LOUIS J RETTGER, dean of the science department of the Indiana State Teachers College, has been elected vice-president of the institution Dr Rettger has been a member of the faculty for forty years.

MR JOHN G BARRY, consulting mining geologist and engineer, has been appointed president of the Texas College of Mines and Metallurgy, El Paso

MR ASHER HOBSON, director of the foreign agricultural crop and market information service of the U S Department of Agriculture, has been appointed professor of agricultural economics at the University of Wisconsin He will be in charge of cooperative marketing. Mr Hobson was for seven years American representative at the International Institute of Agriculture in Rome

DRS CECIL ROBERT BROLYER and DANIEL KATZ have been promoted to be assistant professors of psychology at Princeton University Dr Henry Eyring, lecturer in chemistry at the University of California, and Dr Wendell W Mayer, international research fellow at the University of Munich, have been appointed research associates in chemistry.

THOSE promoted to the rank of professor at the

University of Missouri include Dr Harry H Charlton, in anatomy, and Dr Adrian J Durant, in veterinary science The following appointments are also announced Dr Edgar D Baskett, associate professor of psychiatry, Clarence Mitchell Tucker, of the Florida Experiment Station, associate professor of botany and plant pathologist

Dr George Hermann, of the School of Medicine of Tulane University, has accepted the professorship of clinical medicine at the University of Texas

Mr Humphrey John Denham, of Balliol College, has been appointed director of the agricultural engineering research institute of the University of Oxford

Dr. Theodore H Frison has been appointed chief of the Illinois State Natural History Survey by the Illinois State Board of Natural Resources and Conservation Dr Frison had been acting chief of the survey since the death of Professor Stephen A Forbes in March, 1930

Dr H W von Loesecke, of the Bureau of Chemistry and Soils, has left Washington to take charge of the Citrus By-products Laboratory, now nearing completion at Winter Haven, Florida Dr W W Skinner, assistant chief of the chemical and technical unit, and Dr F C Blanck, in charge of the food research division of the Bureau of Chemistry and Soils, will have general supervision They will study methods of preserving orange and grapefruit by-products, and of utilizing orange and grapefruit wastes as stock and poultry feed

Dr. Walter S Moody retired from active engineering work in the transformer departments of the General Electric Company on July 1, after forty-three years of continuous direction of the design, production and application of transformers Mr Moody was director of the Allegheny Steel Company and has for over thirty years directed the cooperative efforts of the General Electric Research Laboratories and the Allegheny Steel Company

Dr Louise Pearce, of the staff of the Rockefeller Institute for Medical Research, has been appointed visiting professor of syphilology at Peiping Union Medical College, Peiping, China, for six months, beginning on October 1

Dr. L R Jones, professor of plant pathology at the University of Wisconsin, sailed about August 1, to spend several months in the Orient. He plans to visit Japan, China, the Philippines and Hawaii

Dr Constance E Hartt, who has been assistant professor and co-chairman of the department of botany at Connecticut College during the past year, is now engaged in research on potassium deficiency in sugar cane at the Experiment Station of the Hawaiian Sugar Planters' Association, Honolulu Dr Hartt holds the Sarah Berliner Research Fellowship of the American Association of University Women

Dr Vaclav Vojtech, of Czechoslovakia, a member of the Byrd Antarctic Expedition, has arranged to accompany Dr Aleš Hrdlička, of the U S National Museum, on a visit to Alaska Dr Vojtech will investigate the geographical and geological conditions of the peninsula Dr Hrdlička will continue his search for Indian and Eskimo antiquities

Mr Y L Keng, who has been studying the grasses of China at the Grass Herbarium of the U S National Museum, under a fellowship from the Rockefeller Foundation, has gone to the New York Botanical Garden to consult the Chinese specimens there He will also visit the Gray Herbarium of Harvard University, and the Arnold Arboretum He expects to return to Washington about August 20

Mr Lincoln Ellsworth, representing the American Geographical Society, and Commander Edward H Smith, of the U S Coast Guard, are accompanying Dr Hugo Eckener on his Arctic tour in the *Graf Zeppelin,* which left Friedrichshafen on July 24.

It is announced by the Oxford University Exploration Club that the Hudson Strait expedition, under the leadership of Mr H M Clutterbuck, has left for Canada to explore the island of Akpatok and the surrounding regions The party will consist of eleven men, including four biologists, a geologist, a surveyor, a physicist and a photographer The undergraduate organizer and originator of the scheme is Mr C J D'Aeth (Balliol)

At the invitation of the Mexican Government the United States has named the following official delegates to represent it at the third Pan American Medical Association Congress, which meets in the City of Mexico from July 26 to 31, under the auspices of the Mexican Department of Health Dr J C Anderson, State Commissioner of Health, Austin, Texas, Passed Assistant Surgeon H F Smith, a commissioned medical officer of the Public Health Service, now on duty in the office of the American Consul General in Mexico City, Dr Irving R Roth, 45 East 82d Street, New York; Dr John O McReynolds, Dallas, Texas, Dr William Davis Gill, San Antonio, Texas, Dr W E Howard, Dallas, Texas

There assembled on July 25 at Matameck on the north shore of the Gulf of St Lawrence near Seven Islands a conference on wild life in various aspects It has been organized by Mr. Copley Amory, of Boston and Washington, who has a wild life preserve in this locality, and he is bringing to it, largely at his own expense, a body of naturalists from all over the world. Sir George Perley has left for Matameck with a group of scientific men who are in the government's employ at Ottawa. The conference was tendered a luncheon on July 22 by the Province of Quebec when they were welcomed by Hector Laferte, Minister of Colonization, Game and Fisheries.

MR. HENRY O'MALLEY, U. S. Fish Commissioner, arrived at Juneau, Alaska, on July 3, on the fisheries patrolship *Penguin*, accompanied by members of the Senate Committee on Wild Life Conservation, Mr. Paul Reddington, chief of the United States Biological Survey, Mr. Carl Shoemaker, secretary of the Senate Committee on Wild Life Conservation, several Congressmen, and Attorney-General Charles Sisson. The object of their visit is to study game and wild life in the territory, with a view to its conservation. The party will proceed from Juneau to Pribolof Islands, where the seal herd will be inspected, thence back to Bristol Bay, Alaska's largest center for the sockeye salmon, where it will make a survey of the administrative methods of protecting the salmon and the canning industry. The committee also expects to visit Kodiak Island to secure first-hand information on the bear situation. Later it will go to the moose pastures on Kenai Peninsula, and then cruise up Cook Inlet.

SOME information is given in *Nature* in regard to the program of the International Illumination Congress, which is to be held in Great Britain from September 1 to 19. Provision is made for visits to London, Glasgow, Edinburgh, Sheffield, Buxton and Birmingham, following which the sessions of the International Commission on Illumination will be held at Cambridge. An item of outstanding interest in the London program is the proposed trip to the Port of London, returning to the Tower of London and Westminster by river, so that the illuminated buildings on the riverside may be seen. Throughout the visits to the cities named, the technical sessions, at which more than a hundred papers will be presented, will alternate with agreeable trips and social events. During the proceedings at Cambridge a lecture will be given by Sir Arthur Eddington. Membership of the congress is open to any one interested in illumination on payment of a registration fee of £2. Those desiring to take part in the congress should communicate with the honorary general secretary (Colonel C. H. S. Evans, 32 Victoria Street, London, S.W.1).

THE third International Congress of Radiology, under the presidency of Dr. Antoine Beclere, of Paris, opened at the Sorbonne on July 26. The sessions lasted throughout the week. Mme. Curie was honorary president of the congress. Twenty-seven countries were represented. Dr. Albert Soiland, of Los Angeles, was chairman of the American delegation, which numbered forty-five members. A radiological exhibition was held in connection with the congress. Dr. Soiland presented an invitation, asking the congress to hold its next meeting in the United States, but owing to its greater accessibility, Zurich was chosen as the place of meeting of the fourth congress, which will meet in 1934.

THE will of the late Dr. John Osborne Polak, professor of obstetrics and gynecology at the Long Island College Hospital, leaves $350,000 to the hospital, $100,000 for the erection of a science laboratory and $250,000 for a building for private patients for maternity and gynecological cases.

ACCORDING to the *Journal* of the American Medical Association a grant of $100,400 for a three-year period has been set aside by the Commonwealth Fund for a study of the function of the kidney, to be directed by Dr. Alfred N. Richards, professor of pharmacology in the University of Pennsylvania School of Medicine. Dr. Richards has devised methods by which the kidney of the frog can be examined microscopically while it is still functioning in the living body. The program of research includes the continuance and extension of these studies and the establishment of a clinical unit where experimental findings can be correlated with observation of patients suffering from kidney trouble.

DR. FREDERICK L. HOFFMAN, of Wellesley Hills, Mass., has presented to the California Institute of Technology his entire collection of books and data on aeronautics with particular reference to accidents and accident prevention. The collection includes many rare items. Last year Dr. Hoffman presented his entire collection of books and data on the North American Indians to Mrs. Joseph Lindon Smith, chairman of the Welfare Committee, Federation of Women's Clubs. During 1930 also Dr. Hoffman presented many thousands of volumes on foreign countries to the Baker Library, Harvard University.

APPARATUS for taking electric readings involving the electric current and potential as it passes through a given section of the earth's crust, for determining geological structure and as a means of locating ores, minerals, etc., has been invented by Oliver H. Gish, of the department of terrestrial magnetism of the Carnegie Institution, to whom has been granted an American patent. Rights in the patent have been assigned by the inventor to Carnegie Institution.

AN everblooming rose, developed by Henry F. Bosenberg, of New Brunswick, N. J., it was announced recently, has won the first plant patent granted by the United States Patent Office under the new law providing such protection. The patent was assigned to Louis C. Schubert, proprietor of the Somerset Rose Nursery, of New Brunswick, and was obtained by O M Kile, of Washington, acting as special plant agent It covers "a climbing or trailing rose," the patentable feature of which is its everblooming character The owner of the patent has the exclusive right to reproduce, use or sell his invention or discovery throughout the United States and its territories for seventeen years, or to license others to do so

AT a recent meeting of the board of trustees of the Ohio State University, the following resolution was approved "That the interest of the University in the *Ohio Journal of Science* be reaffirmed, and that a more definite plan of cooperation with the Ohio Academy of Science in the publication of the *Ohio Journal of Science* be established, $1,000 from the maintenance fund to be appropriated for the use of the *Ohio Journal of Science,* for the college year 1931–1932"

A FOREST research institute has been made a division of the New York State College of Forestry at Syracuse The purpose in its establishment is to give the work in forest research now carried on by the college in different sections of the state a definite entity and more effective direction Research in forestry in New York is authorized under the charter given the college by the legislature of the state The board of trustees of the college during the past eighteen years has, in carrying out the obligations of the charter, set up special divisions of the college, such as the State Ranger School at Wanakena, the Roosevelt Wild Life Forest Experiment Station and other experiment stations.

AMERICA'S first autogiro has been donated to the Smithsonian Institution by Mr Harold F Pitcairn, president of the American Autogiro Company Mr James G Ray, vice-president of the company, landed the machine on the lawn in front of the Arts and Industries Building on July 22, and the machine was accepted by Secretary Abbot in the presence of a group of distinguished guests It will be exhibited in Power Hall next to an early Wright Biplane

A COLLECTION of graphic charts and anatomical specimens belonging to the Museum of Hygiene of Dresden has been loaned by the museum to the Life Extension Institute and is on exhibition at the head office in New York. The Dresden museum is devoted to the instruction of the general public in the conservation of health. In 1911 the First International Hygiene Exhibition was held in Dresden, which proved to be so successful that its founders and sponsors cooperated in the establishment of the museum as a permanent institution It is the gathering place of hundreds of international scientific associations The health and hygiene sections of the League of Nations meet there regularly The anatomical specimens included in the loan exhibit to the institute have been prepared by a special process which renders them translucent, making possible complete visualization of the underlying vascular and bony structures

DR. C F KORSTIAN, director of Duke Forest at Duke University, Durham, North Carolina, has been notified by Sven Petrini, Secretary-General of the International Union of Forest Research Organizations, Experimentalfaltet, Sweden, of the election of Duke Forest as a member of the International Union of Forest Research Organizations In addition to Duke Forest there are six other forestry institutions belonging to the Union in the United States—the Yale School of Forestry, Harvard Forest, School of Forestry and Conservation, University of Michigan, Forest Soil Laboratory, Cornell University, the Forestry Division of the University of California, and New York State College of Forestry, Syracuse, New York The International Union of Forest Research Organizations originated in 1929 when the International Union of Forest Experiment Stations adopted a new constitution extending its field to include all forest research At the end of 1930 it had fifty-four ordinary and three associate members in more than twenty nations Germany has the largest membership embracing eight institutions, the British Empire has six members and other foreign countries from one to three

THE *Experiment Station Record* states that a gift to the state of New Jersey for administration as a dairy research station has been made of 1,100 acres of crop and pasture land, 270 Guernsey and 55 Holstein cattle, elaborate buildings and equipment The donor is James Turner, of Montclair, a stockbroker in New York City Arrangements have been made whereby the equivalent of the taxes on the property will continue to be available to the townships of Wantage and Beemerville in which the property is situated. The estate consists of two farms, one of 700 acres on which $500,000 is said to have been spent for improvements and the other 3 miles distant and containing 400 acres It is expected that the new station will begin operations immediately. Four projects are contemplated, dealing with the breeding of cattle for milk production, cattle feeding, control of diseases and economic management The residence on one of the farms provides an elaborate administration headquarters and laboratories, and other equipment will be added from time to time. In the words of *New Jersey Agriculture*, "thanks to Mr Turner's vision and generosity, New Jersey will now have one of the largest and most complete dairy experiment stations in the world"

It is reported in *Nature* that the Association of British Zoologists discussed at its general meeting the question of the payment of fees to zoologists for expert advice. It is well known, as Professor E B Poulton says in a letter on behalf of the council of the association, that a somewhat unscrupulous public takes for granted the good nature [and affluence!] of zoologists in requesting their professional help without offering payment in return Whether it be a matter of the identification of a species or the delivering of a popular lecture, both demand the expenditure of time and energy, which the expert could have devoted profitably to his own purposes The council's proposal is that, in the interests of their science, zoologists should demand fees for the work of identifying specimens and giving lectures They say that such a demand would enhance the respect felt for the science, just as medical advice tends to be valued according to the size of the fee

DISCUSSION

REDUCTION OF OXYLUCIFERIN BY ATOMIC HYDROGEN

Some luminous animals, notably an ostracod crustacean, *Cypridina*, contain a substance, luciferin, which oxidizes to oxyluciferin in aqueous solution containing oxygen In presence of a second substance, luciferase, luminescence appears Luciferase acts both as a catalyst, accelerating the oxidation of luciferin, and also supplies molecules which may be excited to emit light by the energy of oxidizing luciferin Oxyluciferin in water solution can be reduced to luciferin by various hydrogenation procedures The mechanism has been fully discussed by Harvey[1]

During attempts to excite luciferase to luminesce by the energy of recombination of hydrogen atoms we have observed that dry oxyluciferin can be reduced to luciferin The apparatus was a modification of that used by Urey and Lavin[2] Atomic hydrogen was produced in a high tension discharge tube at low pressure and drawn over the material exposed about 30 cm from the discharge tube Dry oxyluciferin alone gives no luminescence when luciferase solution is added to it, but dry oxyluciferin first exposed to atomic hydrogen becomes reduced to luciferin, which can then be detected by luminescence on adding an aqueous solution of luciferase No luminescence appears in the atomic hydrogen treated oxyluciferin on adding water alone but only if luciferase is present also, as is to be expected This experiment confirms the results obtained by reducing oxyluciferin in water solution and makes it quite certain that the luciferin-oxyluciferin change is a dehydrogenation-hydrogenation reaction

When dry luciferase and luciferin are exposed to low concentration of atomic hydrogen there may at times be observed a faint bluish glow which breaks into incandescence on raising the atomic hydrogen concentration Dry egg albumen and dry powdered pill-bugs (*Oniscus*) exhibit a dull orange glow in low concentration of atomic hydrogen which may also pass into undoubted incandescence The faint glow of *Cypridina* may be a luminescence or a low temperature incandescence since the containing vessel does become warm Willemite and certain other substances show undoubted luminescence in atomic hydrogen

E NEWTON HARVEY
G I LAVIN

PRINCETON UNIVERSITY

---

[1] *Bull. Nat Res Council*, No 59, p 50, 1927

[2] *J Amer. Chem Soc*, *51*, 3286, 1926

"THE POSSIBLE RÔLE OF MICRO-ORGANISMS IN THE PRECIPITATION OF CALCIUM CARBONATE IN TROPICAL SEAS"

The statement made by Dr Werner Bavendamm, in the issue of SCIENCE for May 29, 1931, on the subject quoted above, compels me to make some critical comments Much as I detest polemics I feel it necessary that those interested in the subject in question have the facts before them

Dr Bavendamm discusses at some length the observations in tropical seas with respect to calcium carbonate precipitation, and makes it appear that his findings are in conflict with mine As a matter of fact, Dr Bavendamm confirms practically all the results obtained in my own studies as reported elsewhere.[1] For example, (1) Dr Bavendamm finds a very small bacterial population in the open sea This confirms my findings and those of others (2) Dr Bavendamm shows that the bacterial population of muds like those off the Bahama Banks is relatively small as compared with those of soil populations. This also confirms my findings (3) Dr. Bavendamm states that investigators have used erroneously the term "calcium bacteria." This is a point which, among several, I emphasized particularly in my papers when I stated that the literature of bacteria shows that many different forms of bacteria have the power of precipitating calcium carbonate under the proper conditions.

---

[1] Publication No 340, Carnegie Institution of Washington, Publication No 391, Carnegie Institution of Washington, 1929.

In view of these statements by Dr Bavendamm, I fail to see why he does not agree with what he calls my ideas and conclusions "based on experiments which were not sufficiently convincing" What Dr Bavendamm probably means is that my experiments are not sufficiently convincing to him

It appears as I read Dr Bavendamm's statement that he bases all his views and attitude on the problem in question on his findings of bacteriological conditions existing in mangrove swamps like those on the coast of Williams Island The fact that bacteria and other micro-organisms exist in large numbers and in great variety in mangrove swamps is not in the least surprising to me, nor can it be to any one who is acquainted with bacterial populations in such material as exists in mangrove swamps To be sure, very little investigation of bacterial populations in such mixtures of organic and inorganic materials has been carried out, and it is highly desirable that much of this work shall be done, but this has little or no relation to the question as to whether or not the calcareous deposits of the earth's surface have been built up through bacterial action in the open sea.

If Dr Bavendamm will consult my papers he will see that I have merely examined critically the possibility of calcium precipitation in any quantity in the open sea through bacteria existing there, and with special reference to the Drew hypothesis I have never claimed that calcium carbonate precipitation could not be effected in such a medium as the mangrove swamps, nor, if Dr Bavendamm reads my papers carefully, will he find the conclusion that the physical-chemical method of calcium carbonate precipitation to which he referred was regarded by me as the only method of calcium carbonate precipitation in the sea. My main contention was, and still is, that no case has as yet been made out for specific forms of bacteria which have as their function the precipitation of calcium carbonate, and secondly, that no case has ever been made out for large-scale precipitation of calcium carbonate in the open sea, by the mechanism postulated by Drew and too hastily approved by geologists, generally speaking.

That many living organisms are concerned with the secretion of calcium carbonate has been emphasized by many biologists That these may have been indirectly concerned with the accumulation of calcium carbonate deposits has also been emphasized by many investigators, but these facts have no bearing on the points originally made by Drew with which I took issue in my publications in this field

Chas B Lipman

University of California

INHERITED TASTE DEFICIENCY

In Science for April 17, 1931, Dr Arthur L Fox, *of the laboratories of the du Pont de Nemours Company*, was reported as having found that certain persons apparently have no ability to taste para-ethoxy-phenyl-thio-urea It was reported that 40 per cent of the individuals tested could not taste the compound, while to the remaining 60 per cent it was exceedingly bitter I immediately wrote Dr Fox asking for some of the compound with which to investigate the possible inheritance of this taste deficiency This is a preliminary report of the occurrence of the condition in one hundred families

First of all, I can confirm Dr Fox's conclusion that the taste deficiency actually exists, and is not a matter of age, sex nor race It is not dependent upon acidity nor alkalinity of the mouth Those tasting it find it bitter, usually exceedingly bitter, even nauseating, while those not tasting it are unable to get any taste at all, even after rinsing the mouth with dilute acids or alkalis

My results to date show 68 5 per cent tasters, and 31 5 per cent with the taste deficiency I have tried it out in families, and the results of the first one hundred families are so conclusive that they are worthy of record The taste deficiency is apparently due to a single recessive gene It is not sex-linked nor sex-influenced When neither parent can taste the compound, none of the children can taste it

Dr Fox tells me that the taste deficiency occurs in other compounds of the phenyl-thio-urea group as well Di O-tolyl-thio-urea behaves somewhat differently from the others, and will be reported on later For the present it is sufficient to establish the taste deficiency as a unit-factor recessive

The results of the study of one hundred families are as follows

		Children	
	No of families	Can taste	Can not taste
Both parents can taste	40	90	16
One parent can taste, the other can not	51	80	37
Neither parent can taste	9	0	17

	Males	Females	Total	Percentage
Can taste	150	151	301	68 5
Can not taste	71	68	139	31 5

Further work is being done on the inheritance of this taste deficiency, its linkage relations and its physiology, and these results will be reported in detail in the near future

L. H Snyder

Ohio State University

GETTING THE STUDENT TO USE HIS OWN INTELLECT

Professor William A Riley in his timely address as chairman of the Section of Zoology of the American Association for the Advancement of Science reverts to the advice given by Huxley in 1869 that, "if the great benefits of scientific training are sought, it is essential that such training should be real, that is to say, that the mind of the scholar should be brought into direct relation with the fact, that he should not merely be told a thing but made to see by the use of his own intellect and ability that the thing is so, and not otherwise"

In discussing the relation of this advice to the present educational situation Professor Riley incidentally raises a question without answering it The question is how far laboratory work as now carried on in secondary schools and colleges is essential to the purpose of inducing students to use their own intellects This topic has recently aroused a good deal of interest among teachers of science and is one which deserves serious consideration.

The usual way of conducting laboratory work is to put into the hands of the student a laboratory manual or sheet of directions which he must follow in order to produce the expected result. Subsequently he reads an assignment in a text-book and listens to a lecture If this is the best possible way to get the student to do his own thinking it fully justifies the expenditure of money, space and time needed for the equipment of the laboratory and the conduct of laboratory courses If it is not the best way and class-room demonstrations, lectures and text-books will serve equally well, then the expenditure is not justified.

Possibly the question might be answered conclusively if the same kind of subject-matter were presented to two classes equal in numbers, age and intellect but working according to the two different methods and at the end of a definite period tested with regard to their ability to solve problems involving application of what they had learned Failing such evidence there may yet be some profit in discussing the probable relative advantages and disadvantages of the two methods in the light of experience both educational and practical.

In actual life more than one kind of thinking is needed. The successful chauffeur or cook must be able to see relations between concrete, material things and swiftly draw the correct conclusions. To me the probabilities are in favor of this ability being developed and strengthened more effectively if the chauffeur or cook actually drives a car or prepares a meal than if he simply watches a demonstration or hears an explanation A combination of the two methods would be still more effective Similarly if, in teaching science, we as educators wish to develop and strengthen the habit of thinking with the aim of producing particular effects on concrete material, a combination of individual laboratory experience with demonstration and explanation is advantageous. If children are being taught botany with the object of becoming better gardeners or farmers there is a real advantage in individual observation and experimentation with seeds and seedlings over demonstration with charts and models A future practical chemist will benefit more by handling apparatus and reagents than by watching some one else do the same thing

When the educational problem is less definite, when science is being taught not with the immediate aim of training for a specific occupation but of developing general mental powers, of establishing a scientific attitude, of giving practice in dealing with abstract as well as concrete ideas and of enabling the student to understand everyday happenings, what are the advantages, if any, of individual laboratory work? Will, for example, powers of observation and comparison be developed better if each student is supplied with specimens of plants or animals and asked to make a list of similarities and differences or if the teacher points them out on a chart or model? Which will leave a more lasting impression of the fact that heat causes gases to expand, for the children to make bubbles rise through water themselves or to watch the teacher do it?

The answer seems obvious The secret of the greater effectiveness of individual laboratory work lies in the increased motivation. Most young people love to be active and to bring about results by their own efforts Interest is greatly enhanced if the problem is sufficiently simple for them to devise their own method of solving it This has the additional advantage of helping to establish the habit of self-reliance.

I believe it is a fact that some laboratory courses do not stimulate initiative and interest and I believe that this is because the laboratory directions make no appeal to the student They are carried out simply as a matter of routine in order to prepare for the lecture or quiz which is to follow. In other words, the chief consideration has been the logical development of subject-matter rather than the stimulation of the student's initiative and powers. The reverse process is better suited to encourage independent thinking When the student's interest and initiative have been aroused he can the more readily be led to realize the necessity of logical arrangement of ideas

Since pupils differ widely in ability to absorb and to utilize knowledge and also in the kind of lives they will lead after leaving school and college, the real success and value of any method will depend on its adaptation to the personality of the pupil The ancient method of professorial lecturing and student note taking is noticeably lacking in objectivity and individualization The opposite extreme of detailed and minute laboratory study of specimens and processes achieves great objectivity at the expense of perspective and broad understanding It fosters habits of mental short-sightedness A middle course is indicated, individual laboratory work suited to the student, supplemented by reading, demonstrations and discussion in which the student has an opportunity to take part

The question has its economical aspect also When a limited sum of money is apportioned to departments of science an obligation exists to expend it advantageously Duplication of simple, inexpensive apparatus easily manipulated by the students and the purchase of single pieces of more complex apparatus for purposes of demonstration would seem best

The entire abandonment of individual laboratory work would surely be antagonistic to the purpose of mental development Research is unnecessary to prove that point Investigation to determine beneficial modifications of present laboratory practice in order that it may be better adapted to the interests and needs of the students would be more to the point

M Louise Nichols

Philadelphia, Pennsylvania

POSITIVE GAS PRESSURE IN POPLAR

In line with a recent article in Science entitled, "Positive Gas and Water Pressure in Oaks," by C A Abell and C R Hursh (Science, 1895, p 449), I am reminded of three cases of positive gas pressure, all in large trees of *Populus tacamahaca* Miller (*P balsamifera* L) in a recent summer in northern Michigan In all three cases there was a distinct hiss as soon as the instrument borer went in about 2–3 cm, which continued during most of the rest of the boring The pressure was not sufficient to force the core out of the increment borer and could be heard only in the vicinity of the tree One of these trees, which was 40 6 cm in diameter, was cut down This tree was sound throughout and bled very actively from the stump

Hundreds of borings on the two aspens (*Populus tremuloides* Michx and *Populus grandidentata* Michx) in no case were accompanied by any evidence of positive pressure

Frank C Gates

Kansas State College of
Agriculture and Applied Science

SOCIETIES AND ACADEMIES

THE NORTH CAROLINA ACADEMY OF SCIENCE

The thirtieth annual meeting of the North Carolina Academy of Science was held at State College, Raleigh, N C, on May 8 and 9 Papers were presented before the general section of the academy on Friday morning and afternoon On Friday evening the retiring president, W F Prouty, professor of geology in the University of North Carolina, gave the presidential address on "The Origin of Folded Mountains" On Saturday morning the academy met in the following sections general section, chemistry section, mathematics section and physics section Eighty papers and twenty-four exhibits were on the program (Abstracts of most of these and complete papers of several will appear in an early number of the *Journal of the Elisha Mitchell Scientific Society*)

Resolutions of respect were passed in honor of two deceased members, William Cain, Kenan professor emeritus of mathematics in the University of North Carolina, and John William Nowell, professor of chemistry in Wake Forest College

The executive committee reported the election of thirty-four new members during the year, and the reinstatement of eight former members One hundred and eighty-six registered at the meeting

Walter Burke Davis, a student of the Greensboro Senior High School, was declared the winner of the high school science prize, a silver loving-cup, for the best essay submitted by a high-school student (Essays for 1931 were confined to the fields of biology and geography)

The officers elected for the year 1931–32 were

General Academy

President, F A Wolf, Duke University
Vice president, W E Speas, Wake Forest College
Secretary treasurer, H R Totten, University of North Carolina
Executive Committee, the above officers, Bert Cunningham, Duke University, W L Porter, Davidson College; F W. Sherwood, N C Agricultural Experiment Station
Representative to the A A A. S, H R Totten, University of North Carolina

CHEMISTRY SECTION

Chairman, L. A. Bigelow, Duke University
Vice-chairman, F. W. Sherwood, State College
Secretary treasurer, H. D. Crockford, University of North Carolina
Councilor, L. G. Willis, State College
Executive Committee, A. S. Wheeler, R. W. Bost and W. C. Vosburg

MATHEMATICS SECTION

Chairman, E. T. Browne, University of North Carolina.
Secretary, E. R. C. Miles, Duke University

PHYSICS SECTION

Chairman, J. L. Lake, Wake Forest College
Secretary, Calvin Warfield, North Carolina College for Women

The thirty-first annual meeting of the North Carolina Academy of Science will be held at Wake Forest College, Wake Forest, N. C., in the spring of 1932.

H. R. TOTTEN,
Secretary

THE VIRGINIA ACADEMY OF SCIENCE

THE Virginia Academy of Science held its ninth annual meeting in Norfolk, on April 24 and 25 with a registration of 242.

The evening address to which the public is particularly invited was delivered by Dr. William A. Kepner, of the University of Virginia, on the subject "A Modern Drift in Biological Thought." There were 111 papers read before the various sections.

A new section was authorized at this meeting—a section on medical sciences. It is expected that the new section will function along the lines of Section N of the American Association for the Advancement of Science. Physicians in Virginia who are interested in the fundamental medical sciences, such as anatomy, bacteriology, biochemistry, embryology, pathology, pharmacology and physiology, will be welcomed to membership in the academy and to participation in the activities of this and other sections.

It is confidently expected that this new section will grow rapidly, as it offers scientifically inclined physicians an opportunity to read scientific papers before an appreciative audience, to take part in stimulating discussions and to become acquainted with other like-minded scientific men.

Dr. I. D. Wilson, of the Virginia Polytechnic Institute, was elected president for the coming year, and Dr. H. E. Jordan, of the University of Virginia, new member of the council.

E. C. L. MILLER,
Secretary-Treasurer

SCIENTIFIC APPARATUS AND LABORATORY METHODS

RUTHENIUM TETROXIDE AS A FIXATIVE IN CYTOLOGY

IN the preparation of certain tissues for microscopic examination, use is frequently made of osmium tetroxide as a fixing or killing agent. This use is largely to avoid coagulants which would materially change the natural structure of the protein constituents of the cell. This note is to call attention to the possibility of the use of ruthenium tetroxide for this purpose, inasmuch as this compound is one of the two examples of the highest state of oxidation known, the other being the corresponding osmium compound.

Ruthenium tetroxide decomposes very readily and is a very energetic oxidizing agent. It is difficult to prevent its decomposition in solution even when kept in the cold and in the dark. We have been most successful in this respect when saturated chlorine water has been used as solvent. Ruthenium tetroxide is supplied in sealed glass ampoules which may be crushed under the cold solvent with no difficulty or danger. It forms a golden yellow solution from which after several weeks a black deposit of the lower oxides of ruthenium separates, at which time its fixing properties have largely disappeared. A stock solution was prepared by breaking a one gram ampoule of the tetroxide under 100 cc of chlorine water. The tetroxide is not very soluble and the greater part remains undissolved so that a saturated solution with respect to the tetroxide is still maintained even after the majority has passed into the lower oxides. For use as a fixative, the stock solution was diluted about twenty times with either distilled water or a ½ to 1 per cent. formic or acetic acid solution.

The ruthenium tetroxide fixative was used extensively on pollen mother cells of *Tradescantia zebrina* (Hort) and closely compared with osmium tetroxide. The ruthenium salt was found to be extremely useful in obtaining the chromonematic structure of the chromosomes at all stages. The morphological results of these studies will be published elsewhere.[1] From our experiences it appears that ruthenium tetroxide is preferable to osmium tetroxide when used for the purpose described. The advantages are, however, partly offset by the fact that ruthenium tetroxide will not penetrate deeply into several layers of tissue, as is possible with the osmium salt. It fixes the outer cell layers very well but it appears to have been mostly decomposed before cells in the interior of a structure can become fixed. Methods to overcome this difficulty are being studied.

---

[1] B. R. Nebel, "On the Structure of the Chromosomes in *Tradescantia zebrina* (Hort.)," *Zeitschr. f. Zellforschg.* In press.

To familiarize the reader with the use of the fixative, the following general procedure is given—(1) Smear anthers between two slides, (2) immediately drop diluted fixative onto slides and leave for 3 minutes, (3) pour off fixative and replace with one drop of Lander's medium (glycerine 40, lactic acid 20, phenol 20 and water 20 per cent.), (4) cover and seal. The fixative should render the material distinctly gray (but not black) during the fixation process when viewed against a white background. Under the microscope the chromonemata appear dark against the gray protoplasm. If staining is desired, a small amount of carmine may be added to Lander's medium or the slides may be dehydrated after fixation and stained by other methods. Treatment with H_2O_2 was found to be distinctly detrimental to maintaining the fixed cell structures.

D. C. CARPENTER
B. R. NEBEL

NEW YORK STATE EXPERIMENT STATION,
GENEVA, N. Y.

A METHOD FOR LOCATING THE LARVAE OF THE MOSQUITO MANSONIA

ENTOMOLOGISTS and sanitary engineers engaged in mosquito work often experience difficulty in locating the breeding places of *Mansonia perturbans* Walk even though the abundance of this mosquito at the particular time and place is such as to make it a very serious pest. The writer has been engaged in investigations of the biology of *Mansonia* in central Florida for the past two years and has developed the method here described for collecting larvae of this insect. Of several methods tried, this has proven the most satisfactory in locating breeding grounds of *Mansonia*.

The larvae of *Mansonia* differ from those of other mosquitoes in that, with the exception of the first few days of larval life, the larval and pupal periods are spent at the bottom of the ponds and marshes where they breed. Peculiar adaptations of the larval air tube and of the pupal breathing trumpets enable them to pierce submerged roots and stems of plants and obtain air therefrom. Difficulty in locating the breeding grounds has undoubtedly arisen on account of the fact that the larvae quickly detach from stems and roots when disturbed and bury themselves in the débris at the bottom of the pond. Thus very rarely are they found by merely examining submerged stems and roots which have been pulled out of the water.

Actually to determine whether or not a marsh is breeding *Mansonia*, the plants over a small area (in practice about one square yard) should first be pulled up, thus disengaging any larvae that may be attached thereto, immediately after which the débris from the bottom of this area, in which if present the larvae are hidden, should be scooped out to a depth of about one inch. This may be done by means of a vessel having a screened bottom. A regular water bucket, the bottom replaced by twenty mesh screen wire, has proven satisfactory for this operation. As each scoop of débris is collected it is placed in a twenty mesh screen wire basket which is held partly submerged and holds in captivity any larvae thus collected. By keeping this basket partly submerged and by occasional shaking a large quantity of mud and minute trash is washed out, thereby lessening the quantity of débris to be examined later. This wire basket may be of any shape, but one recommended on account of ease of construction is conical, having a diameter at the mouth of eighteen inches and a depth of twenty-four inches.

The basket with its contents is next carried ashore for examination. The procedure usually followed in examining the débris is to place a small handful of it in a white enameled laboratory pan, adding about one quart of clear water, and then carefully to search the pan for larvae. If present, the larvae, which are whitish and very active, will be found at the bottom of the pan. Often, however, some individuals, usually those which have been injured by rough handling, are found at the surface of the water.

The number of these examinations necessary to determine whether or not a given area is infested with *Mansonia* will, of course, depend on the size of the marsh and on the number of different types of environment present therein.

T. E. MCNEEL

BUREAU OF ENTOMOLOGY,
ZELLWOOD, FLORIDA

SPECIAL ARTICLES

ON ATMOSPHERIC ELECTRICITY

ACCOUNTS of certain remarkable effects of atmospheric electricity on the growth of plants have been reported by enthusiasts both in this country and abroad. Yield increases of more than thirty per cent have been reported from fairly definite and systematic yield tests. The results of other investigations have been negative, no significant yield increases having been obtained through the use of the electrical charge as secured from the air

In order to check some of these results, experiments were instituted at the Agronomy Farm of Iowa State College by the departments of farm crops and soils and of physics, during the spring and summer of 1930

No significant differences in yields were obtained as a result of the first year's trials However, these tests were not taken as very conclusive as the summer was very dry and the amounts of charge obtained throughout the period were exceedingly small The tests are to be continued for the coming season

During the course of the experiments some effects of a purely electrical nature appeared which it seemed worth while to investigate further It has been found by several investigators that there is a continual current of electricity flowing between the earth and the air The work of C T R Wilson (*Phil Trans*, 221 73, 1921) (*Proc* Roy Soc, A vol 80, p 539, 1908), Schonland (*Proc* Roy Soc, A vol 118, p 229, 1927), Swan, (*I C T* VI, 442), and others indicate that the direction of the positive current is from the air to the earth during fair weather, *i e*, the earth is losing negative charge, and that during storm periods, the current is more often in the other direction According to Wilson (*Proc* Roy Soc, A vol 80, p 539, 1908), and Gerdien (*Physikal Zeit*, p 647, Jahr 6, 1905), this fair-weather current for the whole earth amounts to about 1,000 amperes

The plot of ground under investigation in our experiments was one hundred and fifty feet square This was wired about twelve inches under ground with copper radio cable, the wires extending entirely across the plot north and south, being spaced thirty feet apart east and west The apparatus used for collecting the charge from the atmosphere consisted of one original Christofleau apparatus (*Bull* of the Etablissement J Christofleau Industriel) and four variations, three of the Vincent type and one of our own These were essentially brushes of wires on an iron standard, the brushes containing from eighteen to twenty-seven wires The lengths of the wires varied from approximately six inches to eighteen inches and they were so arranged on the standard that the tops of the wires were about even The diameters of the brushes varied from about eight inches to fourteen inches Our design was slightly different, consisting of six brass bars eighteen inches long, radiating from a central plate and carrying several copper wires projecting upward These "heads" were mounted on 4" x 4" poles twenty feet high, bolted permanently to posts set solidly in the ground The heads were insulated from the poles by a resistance composition of slag oil and clay made by the Vulrox Co, of St Louis. The connecting wires leading down the poles were mounted on glazed insulators These were connected through a series of switches to one plate of a high grade mica condenser, the other plate being connected to the ground wires A high sensitivity Leeds and Northrup ballistic galvanometer was used to measure the charges collected Another Leeds and Northrup R type high sensitivity galvanometer was installed to measure the current directly, but it was useless during the summer except during showers when the currents became sufficiently large to produce appreciable deflections

The poles carrying the collector heads were erected along the south side of the plot under investigation, and about two feet inside a woven wire fence which inclosed the south and west sides of the plot There were several tall trees to the north of the plot but as none of these were within 160 feet of our apparatus, it was not thought that they would materially affect the results A cinder road ran along the south side of the plot and on account of the very dry weather of the last summer, was usually quite dusty Clover and small grain were grown across the road and corn to the east of the plot The plot itself contained corn, soy beans, turnips, garden beans, and swiss chard The measuring instruments were housed in a sheet-iron shack at the southwest corner of the plot.

From June 25 to July 10 the currents were upward, *i e*, the ground was gaining negative charge These currents were small, being of the order of 5×10^{9} ampere This is about one hundred times the average fair weather current as given by Wilson but as points were used here as dischargers, larger results were to be expected The last rain of the season of any considerable quantity occurred on July 4 so that by July 10 the ground was quite dry and remained so until about the middle of September. The summer was very hot, the temperature on several days reaching 98° F or higher during the afternoon During the interval from July 11 to September 6, when readings at this location were discontinued, the prevailing direction of the currents (except during light showers) was downward The currents during this period were very small being of the order of 5×10^{10} ampere

Late in October, the apparatus was dismantled and three of the heads mounted on the top of the physics buildings The height of the heads above the ground was about thirty feet The mounting was similar to that used previously except bakelite replaced the slag oil composition as insulator and a ground plate replaced the long ground wires Several small rains had fallen in the interval between the last readings taken at the farm and the installation of the instruments on the building. The currents during most of the time since have been large enough to measure directly with the type R galvanometer, or of the order of 5 x 10^{-9} ampere. These are about the same as those of June, 1930, and in the same direction, i.e., upward currents.

It will be noted in this connection that our results, except during the very driest part of the last summer, are in direct contradiction to the fair weather results of the investigators mentioned above. Our results indicate that in this vicinity the earth is nearly always gaining negative charge. Our results check the others for the prevailing direction of the current during a rain, i.e., that the earth is gaining negative charge. It was also noted that, during a thunderstorm, the direction of change of field during a lightning stroke, was predominately in one direction.

Most of the changes noted occurred when the storm was overhead so that the distance to the points of discharge were comparatively short. All the changes in field—with two exceptions—were positive, i.e., the fields set up by the discharges were downward. One of these two exceptions occurred as the storm was approaching and was quite small. The other occurred while the storm cloud was overhead and was comparatively strong. These results check those of Schonland and Craig for near discharges (*Proc. Roy. Soc.*, A vol. 114, p. 229, 1927). As there was only one observer and he was continually occupied with the measuring instruments and as the storm was approaching from the opposite side of the building, there was no opportunity to note the character of the discharges or to make any actual estimates of the distances to the points of discharge.

Thinking that there might possibly be some error in our method of determining the direction of the current, an electrometer was set up and the direction again determined. Both galvanometers and the electrometer gave the same results. Frequent tests were also made to determine whether the direction of the currents noted might not be due to small e.m.f.'s developed in the switches but no evidence to this effect was found.

While the apparatus was set up in the field, it was noted that whenever an auto passed stirring up a cloud of dust which drifted across the apparatus, there was an added current set up. This was always in one direction and was interpreted as being due to tribo-electricity generated between the rubber tires of the car and the cinders on the road. Without exception, however, this was followed at an interval of about thirty seconds by a reverse current. This reverse current has not been explained.

C. S. Dorchester
L. W. Butler
Iowa State College

USE OF PROTOZOA IN MEASURING THE NEUTRALIZING VALUE OF COBRA ANTI-SERUM[1]

In previous studies of the effect of toxins and venoms on protozoa[2] it has been shown that paramecia may be used in measuring the potency of venoms. Attempts were made to use paramecia in measuring the neutralizing value of the anti-serum of Crotalus (rattlesnake) venom, but results were not wholly satisfactory. More recently the study has been extended to the use of paramecia in measuring the strength of cobra anti-serum. In this the results have been more satisfactory. It is the purpose of this paper to describe the methods used and the results obtained in ten different titrations where paramecia were used in measuring the neutralizing value of a sample of cobra anti-serum.

The method which was used in measuring the strength of the cobra anti-serum consisted in placing paramecia (in each case four animals in 1 cc) in various mixtures of cobra venom and anti-serum and thus determining the least amount of anti-serum required to protect the animals from a given amount (0.000005 gram) of venom. The method and results of ten different titrations are shown in the accompanying table.

The venom which was used in these titrations was supplied in desiccated form by the Pasteur Institute. A stock solution of this venom was made by dissolving 0.05 gram of the dry venom in 9 cc of distilled water to which 1 cc of glycerine had been added. This solution was brought to a pH of 7.0 by the addition of Na_2HPO_4. This stock solution did not deteriorate in strength during the period of the investigation and was used in making all dilutions of venom indicated in the accompanying table. The solution was kept at from 5 to 10° C. Repeated titrations showed that the least concentration (minimal lethal concentration) of this venom required to kill paramecia (*P. multimicronucleatum*) was 0.000002 gram per cc and that the maximum tolerance of this species of paramecia for the venom was 0.0000016 gram per cc of medium.

The anti-serum used in these titrations was a sample supplied in desiccated form by the Pasteur Institute. A fresh stock solution of the desiccated anti-serum was made up for each titration shown in the accompanying table. This, in each case, was made by weighing 0.05 gram of the desiccated anti-serum (the equivalent in this case of 0.5 cc of liquid anti-serum) and dissolving in 10 cc of neutral distilled water. From such stock solution all dilutions of the anti-serum shown in the table were made.

---

[1] This study was aided by a grant from the National Research Council.

[2] C. H. Philpott, *Jour. Exp. Zool.*, vol. 56, No. 2, *Jour. Morph. and Physiol.*, vol. 46, No. 1; *Proc. Soc. Exp. Biol. and Med.*, vol. 26, *Biol. Bull.*, vol. 60, No. 1.

TEN TITRATIONS OF COBRA ANTI-SERUM IN WHICH PARAMECIA WERE USED AS TEST AGENTS

Amount of cobra venom per cc of mixture	Amount of serum per cc of mixture	Number of paramecia added to 1 cc of mixture	Number of animals remaining alive after 1 hour Temperature 20° C									
	Anti serum		Titration number									
gram	cc		1	2	3	4	5	6	7	8	9	10
0.000005	0.0005	4	0	0	0	0	0	0	0	0	0	0
"	0.0010	4	0	0	0	0	0	0	0	0	0	0
"	0.0014	4	0	0	0	0	0	0	0	0	0	0
"	0.0019	4	2	0	3	0	1	0	0	3*	0	1*
"	0.0024	4	4	0	3	0	2	2	0	3	1	1
"	0.0029	4	4	4	4	3	4	4	0	4	4	4
"	0.0033	4	4	4	4	4	4	4	4	4	4	4
"	0.0038	4	4	4	4	4	4	4	4	4	4	4
	Normal horse serum, cc											
"	0.0005	4	0	0	0	0	0	0	0	0	0	0
"	0.0010	4	0	0	0	0	0	0	0	0	0	0
"	0.0014	4	0	0	0	0	0	0	0	0	0	0
"	0.0019	4	0	0	0	0	0	0	0	0	0	0
"	0.0024	4	0	0	0	0	0	0	0	0	0	0
"	0.0029	4	0	0	0	0	0	0	0	0	0	0
"	0.0033	4	0	0	0	0	0	0	0	0	0	0
"	0.0038	4	0	0	0	0	0	0	0	0	0	0

* Animals in pathological condition.

The medium used in making all dilutions from the venom and anti-serum stock solutions consisted of a 0.025 per cent. solution of beef extract in non-toxic distilled water. This medium was brought to a pH of 7.3 by the addition of Na_2HPO_4 and was kept in sterile condition until time for use.

The mixtures of venom and anti-serum which are described in the accompanying table were allowed to stand at 5° C. for from 10 to 60 minutes before testing their effects on paramecia. It was found that under these conditions neutralization of the venom was as complete in 10 as in 60 minutes. It was also found that the venom in these mixtures deteriorated to some extent when the solutions stood at room temperature and in the presence of sunlight.

The animals used in these titrations came from a culture of *Paramecium multimicronucleatum* obtained from Dr. L. L. Woodruff, of Yale University. All animals used were the descendants of one animal isolated at the beginning of the investigation.

It is evident from an inspection of the data in the accompanying table that the least amount of the anti-serum required to sufficiently neutralize 0.000005 gram of venom so that paramecia are able to live in the mixture is from 0.0019 to 0.0029 cc of the anti-serum per cc of mixture. Considering the fact that these animals are normally able to tolerate 0.0000016 gram of cobra venom per cc of mixture it follows that 0.0000034 gram of the venom is neutralized by from 0.0019 to 0.0029 cc of the anti-serum. From this it may be calculated that 1 cc of the anti-serum neutralizes from 0.0011 to 0.0017 gram of cobra venom. The Pasteur Institute, using warm-blooded animals as test agents, reported this anti-serum to have a neutralizing value of from 0.0009 to 0.00125 gram of cobra venom per cc. The titre obtained with the use of paramecia and that obtained by the Pasteur Institute, where warm-blooded animals were used in the test, are essentially in agreement.

It is the belief of the writer that the above described method of determining the strength of cobra anti-serum is reliable and that it could be used routinely.

CHARLES H. PHILPOTT

DEPARTMENT OF ZOOLOGY,
HARRIS TEACHERS COLLEGE, AND
DEPARTMENT OF BACTERIOLOGY AND
IMMUNOLOGY OF THE WASHINGTON
UNIVERSITY MEDICAL SCHOOL

BOOKS RECEIVED

ASSOCIATION OF FIELD ENGINEERS. *Bulletin, June, 1931.* Pp. 119. Illustrated. The Association, U. S. Coast and Geodetic Survey.

BIGELOW, HENRY B. *Oceanography.* Pp. vii + 263. Houghton Mifflin. $2.50.

BRYAN, CYRIL P. *The Papyrus Ebers.* Translated from the German. Pp. xl + 167. 16 plates. Appleton. $3.00.

CAULLERY, MAURICE. *Le Problème de l'Evolution.* Pp. 448. 88 figures. Payot. 40 fr.

COHN, ALFRED E. *Medicine, Science and Art.* Pp. xiii + 212. University of Chicago Press. $4.00.

CRUM, ROY W., editor. *Proceedings of the Tenth Annual Meeting of the Highway Research Board.* Pp. 420. Illustrated. Division of Engineering and Industrial Research, National Research Council. $2.00.

ENTZ, G. and F. VERZAR, editors. *A Magyar Biologiai Kutató Intézet Munkái.* Arbeiten Des Ungarischen Biologischen Forschungsinstitutes. Volume III. No. 1. Pp. 296. Volume III. No. 2. Pp. 297–526. Illustrated. Tihany.

GARDINER, J. STANLEY. *Coral Reefs and Atolls.* Pp. xiii + 181. 15 plates. 33 figures. Macmillan. $4.25.

HALL, WILLIAM T., editor. *A History of Chemistry, by F. J. Moore.* Second edition. Pp. xxiii + 324. Illustrated. McGraw-Hill. $3.00.

KANNER, LEO. *Judging Emotions from Facial Expressions.* Pp. iv + 91. Illustrated. Psychological Review Company.

MITCHELL, C. AINSWORTH. *The Scientific Detective and the Expert Witness.* Pp. xiii + 242. 64 figures. Appleton. $2.00.

ROSS, J. D. *New Views of Space, Matter and Time.* Pp. xxii + 393. 69 figures. 15 plates. Gateway Printing Company.

TÔHOKU IMPERIAL UNIVERSITY. *Science Reports.* Fourth Series: *Biology.* Volume VI; Number 2. Pp. [illegible]–346. Illustrated. Maruzen Company, Tokyo.

SCIENCE

Vol. 74 Friday, August 14, 1931 No 1911

The Internal Secretions and Human Well-being Professor M F Guyer 159

Scientific Events:

Drought in the Nesting Areas of Waterfowl in the United States and Canada, The International Passamaquoddy Fisheries Commission, The Faraday Celebration, The Joseph Henry Lectureship of the Philosophical Society of Washington 166

Scientific Notes and News 168

Discussion

The Uncertainty Principle and Free Will Professor Arthur H. Compton *Geomorphic Nomenclature* Dr F Bascom *Lord Kelvin's "Mortal Spring"* Professor Evan Thomas *On "The New Cytology"* Professor Jean Oliver *Chromosomes of Petunia* Dr Alice M Ottley *Newton's Saying* Dr. Charles Herrman 172

Societies and Academies

The Second International Congress of the History of Science and Technology Dr. David Eugene Smith 175

Scientific Apparatus and Laboratory Methods

A Triple spectrum Discharge Tube R William Shaw and George B Sabine. *The Adjustable Double Slit*. Professor Paul Kirkpatrick 179

Special Articles

Further Observations on an Inhibitor Principle Associated with the Causative Agent of a Chicken Tumor Dr. James B Murphy and Ernest Sturm *Human Serum, Age and Multiplication of Homologous Fibroblasts* Dr. Raymond C Parker *A Practical Test for Potency of Extract of Corpora Lutea* Dr. Reginald G Harris and Dorothy M Newman 180

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa. Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE INTERNAL SECRETIONS AND HUMAN WELL-BEING[1]

By Professor M. F. GUYER

UNIVERSITY OF WISCONSIN

Perhaps there is no field of biological investigation to-day that is attracting more attention on the part of both biologists and the public than that concerned with the glands of internal secretion—secretions which do not pass out from their place of origin through ducts as do ordinary glandular products, but which are absorbed directly into the blood or lymph and circulated through the body. The interest of the public has been aroused in this new knowledge through its rather wild exploitation in the press under such captions as "The Chemistry of the Soul," "The Glands of Destiny," "Rejuvenation through Monkey Glands" and other equally sensational titles, together with the occasional truths that filter through from time to time regarding the really remarkable part played by the internal secretions—or hormones as they are technically called—in our physical and mental well-being

The ductless or endocrine glands which produce these various internal secretions occur in all backboned animals from fishes to man The secretions themselves are second in importance only to the nervous system in keeping the parts of the body in harmonious operation They are also necessary for normal development and growth They can stimulate or inhibit the activity of some organ or tissue in a part of the body far distant from the source of the secretion itself. While the modest achievements of the biologist, the pathologist and the biochemist toward an understanding of the nature and functions of the internal secretions do not measure up to the expectation of a public appetite fed mainly on sensationalism, still the facts, unmagnified by the imagination, are certainly both interesting and significant

---

[1] Address given at the forty-fifth annual meeting of the Iowa Academy of Science, May 1, 1931; in substance, a section from the author's forthcoming textbook, "Animal Biology," published by Harper and Brothers.

Many physical and even mental abnormalities in man are being traced to deficiencies of the endocrine glands, or to upsets of their normal interrelations at different physiological periods in the individual Height, the general form and external appearance of the body, whether slender or broad, the length of arms and legs, the shape of the face, the quality of the voice, the distribution of hair or of fat on the body, and even the emotions are in greater or less measure conditioned by the relative functionings of these regulative substances during early development and later life Furthermore, the amount and quality of the internal secretions in various family strains are probably as much the expression of hereditary factors as are many other individual characteristics, hence the problem as it affects existing personality and health is not only one of present physiology but also one of parentage

The known endocrine glands are the thyroid, the parathyroids, the pituitary body, the adrenals, the sex-glands and special areas in the pancreas, the stomach and the upper intestine The pancreas, male sex-glands and the glands of the stomach and intestine also form other secretions for the discharge of which ducts are provided The hormones formed in these glands, however, as in the ductless glands, are absorbed directly into the blood and lymph The thymus, pineal body, spleen, liver, lymph glands, kidneys and heart have also been suspected of endocrine functions, although the evidence as yet is inconclusive.

The thyroid arises embryologically as an outgrowth from the digestive tract in the neck region, it soon becomes shut off from its place of origin, however, to form a ductless gland Its final position and appearance vary considerably in different kinds of vertebrates In man it consists of two lobes attached to the sides of the lower portion of the larynx, connected by a narrow band across the midline. The thyroid of an average sized, normal man weighs from 20 to 25 grams It is slightly larger per unit of body weight in woman, and still larger in proportion to body size in children Its secretion plays a very important part in maintaining a proper balance of the nutritional and growth processes The active principle, known as thyroxin, was first isolated by the biochemist Kendall in the form of an organic iodin compound containing no less than 60 per cent. of iodin It is now prepared synthetically by chemists, the artificial product is apparently as effective as the natural

Thyroxin regulates the rate of oxidation in the body Over-abundance (hyperthyroidism) increases the heart-beat, causes higher temperature, and in general speeds up the body activities Thyroid insufficiency (hypothyroidism) on the other hand, causes the chemical processes of the body to proceed sluggishly glandular, muscular and mental activities are impaired, the temperature is lowered, and in adults the skin, especially of the face and hands, may become puffy from the presence of underlying mucus (myxedema) Inadequate development or atrophy of the thyroid in the young child produces a condition known as cretinism characterized by stunted body and imbecile mind The tongue and abdomen of the cretin tend to protrude and the legs are usually bowed Such children, if taken in time, often show remarkable improvement, both in body and mind, following administration of thyroxin

Simple (or endemic) goiter is a pathological enlargement of the thyroid gland That iodin deficiency is an important and possibly the sole cause is indicated by the fact that many remarkable cures have been effected in early stages through the administration of iodin in some form and by the fact that this form of goiter may be largely prevented through the use of food which contains traces of iodin or by the occasional addition of small quantities of iodin salts, commonly sodium iodide, to ordinary food That this is an important matter is evident from the fact that in the so-called "goiter belts" some 20 to 30 per cent. of the male and some 50 to 60 per cent of the female inhabitants show at least traces of thyroid enlargement Goiter is two to three times more prevalent in females than males It is very common in the Great Lakes region of our own country and is usually found in glaciated regions where the iodin content of soil and water is low as compared with that of coastal plains Goiter may occur in any land or fresh-water vertebrate Animals living in the sea are free from it probably because sea water is rich in iodin The enlargement is brought about apparently by overwork on the part of the gland in an attempt to secrete enough thyroxin for the use of the body in spite of an insufficient intake of iodin Such an effect is termed compensatory hypertrophy. It is probable also that at times increased need in the body for the iodin-containing hormone may be a factor in goiter production It is most likely to occur at the times of life when energy transformations are greatest such as, in man, during fetal life, puberty, in periods of pregnancy and lactation and toward the conclusion of the child-bearing period in women

As affecting development some interesting experiments have been performed with thyroid upon tadpoles Guternatsch discovered that both frog and salamander tadpoles fed on thyroid are forced into premature maturity. Frog tadpoles quickly develop legs, absorb their tails and transform into miniature frogs, sometimes no larger than a fly Allen has shown, on the other hand, that a young tadpole deprived of its thyroid is unable to become a frog though it continues to live and may grow far beyond the normal size of a tadpole If at any time such a tadpole is fed thyroid, however, it promptly undergoes metamorphosis Thyroxin seems to be the same substance wherever found in the vertebrates from lamprey to man

Although so necessary to the proper operation of physiological processes, only a very small trace—not over 12 milligrams or one fifth of a grain—of thyroxin is present in the normal body at one time One milligram of thyroxin fed to a man at rest weighing 150 pounds will increase his rate of oxidation 2 per cent for twenty-four hours The total amount of this substance needed for an entire year to keep the human body in normal health is only about three and one half grains, yet lacking this, the individual becomes an imbecile The so-called basal metabolism test is employed to discover if too much or too little thyroxin is present in an individual A normal resting person who has not eaten for twelve hours produces a remarkably constant amount of energy in a given time as shown by the even carbon dioxide output which results from internal oxidation In people suffering from goiter or from lack of thyroid activity, the severity of the hyper- or the hypo-thyroidism is judged by the deviation of the rate of internal oxidation from that of a normal person

The parathyroids (Gr *para*, near, and *thyroid*) in man exist as four minute glands weighing in all not over two grains They are closely attached to the thyroid, one on the side and one on the median surface of each lateral lobe They have been identified in all kinds of vertebrates except fishes. The secretion from the parathyroids controls the calcium content of the blood, and since calcium is of great importance in many physiological processes from clotting of blood and muscular tone to formation of the skeleton, the proper functioning of these glands is all-important to the organism. Complete removal brings about a condition known as tetany, characterized by painful spasmodic contractions of the muscles of the extremities. The calcium content of the blood is greatly diminished. The heart, the respiratory tract and the temperature of the body are also affected. Death results in a few days after the removal of the glands if the condition remains untreated. Injection of a soluble calcium salt will relieve the attack of tetany and restore the sufferer to normal for a time.

The thymus is a glandular structure which in man is located in the upper chest region along the trachea In lower forms such as fishes it may take the form of a number of separate bodies Although commonly regarded as a ductless gland its function is a matter of debate. The secretion has never been successfully isolated. By some it is thought to be a structure which functions in the formation of blood Since, in man, it attains its maximal size and activity in early childhood, the inference is that it fulfills some important function in the young developing organism. After the second year of life, ordinarily it gradually grows less in size until usually at about the end of the thirteenth year it is supposed to disappear However, cases of "persistent thymus" are not uncommon At first supposed to be confined to individuals characterized by prolonged childhood, and to be particularly characteristic of feebleminded adults, renewed study of cadavers shows that persistence in apparently normal individuals is by no means uncommon Young dogs in which the thymus has been completely removed develop a softening of the bones, and surgical removal in a human being is said to produce a disordered development of the skeleton similar to that of a child with rickets

The pineal gland is a small body in the brain of vertebrates, projecting from roof of the third ventricle, from which it is an outgrowth In man it is about the size of a pea The philosopher Descartes regarded it as the seat of the soul! There seems to be some evidence that it secretes a hormone, although it has never been isolated. The gland seems to be most active during childhood and by some endocrinologists is believed to take over the supposedly inhibitive functions of the thymus after the second year of life Early destruction or degeneration of the gland, as by a tumor, has been found associated with precocious sexual maturity in a few children. Delayed retirement of pineal activity is alleged by some endocrinologists to lead to obesity and retardation of sexual development.

The pituitary gland is a small body of double origin, attached by a stalk to the base of the brain It occurs in all vertebrates from hag-fish to man The anterior portion arises embryologically from the roof of the mouth, and the posterior portion is an evagination from the floor of the brain immediately above the mouth The respective outgrowths fuse to form what is commonly called the pituitary body or gland. The posterior part forms the posterior lobe or *pars nervosa* of the pituitary gland. The anterior outgrowth ultimately gives rise to three distinct parts—an anterior lobe, an intermediate lobe and a thin layer called the *pars tuberalis*, which comes to surround the stalk and extend upward onto the base of the brain The different parts have different functions

In normal man the pituitary body is a small structure about the size of a hazel-nut, weighing approximately 0 6 gram. It lies in a bony depression (*sella turcica*) of the sphenoid bone in the floor of the skull. The earlier work done with extracts from the posterior lobe produced seemingly very divergent results due probably to the fact that such substance is easily injured by the reagents used in its preparation, to differences in size of dose, and probably also to the fact that, as recent investigation has shown, more than one hormone is involved

The most consistent results obtained from use of the entire extract of the posterior lobe are: (1) extraordinary potency as a stimulant of smooth muscle (hence its use in hastening child-birth by causing powerful uterine contractions), (2) prolonged rise in arterial blood pressure, (3) a diuretic (increasing the secretion of urine) action, or, under some conditions, an antidiuretic reaction, and (4) characteristic cardiac, glandular and respiratory effects. Kamm and his coworkers, however, have succeeded in separating from powdered posterior lobe substance two products, one of which acts powerfully on blood-pressure but has very slight action on uterine muscle while the other does not affect blood-pressure but is a powerful stimulant of uterine contraction In addition to these substances two materials which lower blood-pressure are known to exist in posterior lobe extracts

The secretion of the anterior lobe is best known through its growth-stimulating and ovulation-inhibiting effects Over-activity of this lobe probably leads to gigantism, insufficiency, to dwarfing Removal of the anterior lobe in young experimental animals results in a marked stunting in size. Injections with anterior lobe extracts, however, cause growth to be resumed By daily injections of anterior lobe-substance into the body-cavity, giant rats have been produced In one case a treated animal became more than double the size of untreated litter mates Gigantism has likewise been similarly induced in various amphibia. Autopsies on various human giants have revealed tumorous and enlarged pituitaries If the excessive secretion begins in youth while the growth zones of the bones are still unossified, lengthening of the bones, particularly of the arms and legs, occurs, and a form of gigantism is the outcome; but if such overactivity does not appear until maturity a different type of enlargement occurs in certain bones, notably those of the hands, feet and face, and a condition of deformity known as acromegaly results

As regards sterilization by means of anterior lobe extract, the contradictory reports which have filled the literature for the past few years seem at present in a fair way of being cleared up Most studies have reported inhibition of ovulation in mice and rats following hypodermic injections of the extract A few, particularly where minimal amounts were used, have recorded increased ovulation and the precocious maturity of young animals Miss Claus, however, succeeded in isolating a crystalline product from the anterior lobe which very materially hastens sexual maturity in young mice The residue left after the removal of such crystals was shown still to contain the growth-promoting and the ovulation-inhibiting substances Thus there are evidently at least two different hormones in the anterior lobe secretion, and it seems not improbable indeed that this non-crystalline residue may be further fractionated into two, making three in all

Working with frog tadpoles, B M Allen has shown that limb development ceases at a certain point following removal of either the thyroid or the pituitary gland or both He interprets his results as indicating a close correlation of function between the two He has demonstrated also that tadpoles from which the pituitary body has been removed lag greatly in growth but that following implants of the anterior lobe alone, growth rises rapidly to normal again Implantation of either the intermediate or the posterior lobe has no such restorative effect Striking increase in pigmentation in such tadpoles, however, is produced by implantation of the intermediate lobe

One of the most spectacular effects of transplanting the anterior lobe is perhaps that obtained by Miss Wolf on the breeding habits of the ordinary leopard frog (*Rana pipiens*) This animal breeds once a year, in April, laying its eggs in lakes, streams and fresh-water pools. However, females treated in the fall or early winter with daily implants of a single fresh anterior lobe taken from another frog may be stimulated in from four days to a week to lay eggs in a perfectly normal manner. Males similarly treated, after the second or third treatment, usually begin to sing as they do during the mating season in spring, and in the course of a few days all the normal mating instincts appear, the eggs are fertilized and normal development occurs. Tadpoles are now secured in this way in our own laboratories at any time we may need them for class or individual work.

Taking pituitary secretion as a whole the available evidence shows that an excess increases the basal metabolic rate and that a deficiency leads to excessive obesity and retardation of sexual development Indications of close interrelation between the pituitary and various of the other endocrine glands such as thyroids and ovaries are steadily accumulating

The pancreas is seemingly a gland concerned primarily with the elaboration of a digestive fluid which is discharged through the pancreatic duct into the upper intestine. Scattered throughout the pancreas, however, among the lobules which secrete the ordinary pancreatic juice, are small independent areas of a very different-looking tissue known as the islets of Langerhans These cells secrete a substance known as insulin which passes directly into the bloodstream and serves, probably in cooperation with the secretion of the adrenal glands, to control the metabolism of sugar in the body If these islets are incapacitated in some way an insufficiency of insulin occurs and a condition known as diabetes (*diabetes mellitus*) results A characteristic symptom of diabetes is increase of sugar in the blood and later the appearance of sugar in the urine. Insulin was discovered, and a method of preparing it from the pancreas of healthy animals was perfected by Banting, Macleod and associates This preparation is now widely used in the treatment of diabetes and is restoring the general health and prolonging the lives of many diabetics. It is interesting to note in connection with the pancreas also that secretion of the pancreatic digestive fluid does not proceed until the pancreas is stimulated by a hormone known as secretin. Secretin in turn is produced in the walls of the small intestine as a result of the entrance of the acid contents of the stomach following gastric digestion

The adrenal glands as the name implies (L *ad*, near; *ren*, kidney) are associated with the kidneys, although in the lower mammals they are not as closely connected with it as in man. Each gland is a double structure of dual embryonal origin The core or medullary portion springs from certain cells of the adjacent sympathetic nervous system, while the cortical portion which comes to envelop the medulla is derived from the lining of the body cavity The secretions from the two parts differ in physiological action. Inasmuch as cells giving reactions similar to those of the adrenal medullary cells have been described in annelids and mollusks adrenal secretion or its equivalent seems to be of wide occurrence in the animal kingdom. The adrenal glands of man are two small structures of a yellow color, which cap the kidney and weigh about 4 grams each. They are about the size of a man's thumb.

The secretion from the medullary portion of the adrenal gland, called adrenalin or epinephrin, has not only been isolated in a pure state but has also been synthesized in the laboratory and is widely used as a drug. In the body it is of great importance in maintaining muscular tone, the proper amount keeps the blood vessels suitably contracted and blood pressure normal. It is normally present in blood in about the ratio of only 1 part to 20,000,000

Insufficiency of adrenalin in the blood results in lowered blood-pressure, lack of muscular tone and the general loss of strength and "nerve" which is characteristic of neurasthenia, "shell-shock" and related ills In general, adrenalin affects the same structures of the body that the sympathetic nervous system does, namely, the heart, blood-vessels, kidneys and other viscera, and the involuntary muscles It is widely used in minor surgery because it constricts blood-vessels and thus checks bleeding Tadpoles fed on adrenal gland become extremely light colored or "bleached," apparently because it produces contraction of the pigment cells Injection of adrenalin into the blood leads to increase in the quantity of sugar in the blood through release of the sugar from liver glycogen It apparently counter-balances the action of insulin It is used medicinally to relieve bronchial spasms in asthma, and in conjunction with local anesthetics for constricting blood-vessels and thus preventing rapid diffusion of the injected substance. It is also sometimes used in attacks of hives or hay fever Injected directly into the heart in certain cases of collapse, it will sometimes, through its effect on certain nerves, initiate renewed contraction in a heart that has ceased to beat

Professor Cannon and his associates conclude from their experiments that under stress of such emotional states as pain, suffocation, fear or rage, the adrenals are stimulated to an increased output of adrenalin Cannon calls attention to what he regards as the remarkable adaptive character of the reactions which follow, in that they supply the body with muscular power to resist or carry out any of the actions that may take place under these emotions for the welfare or preservation of the individual According to him the sugar of the blood—the most favorable source of muscular energy—increases in quantity, if digestion is in progress its activities are suspended and the blood is shifted to the organs immediately necessary for muscular exertion—the lungs, heart and central nervous system, the blood becomes more coagulable, heart action becomes more vigorous, muscular fatigue is counteracted by the extra adrenalin, in brief, such fundamental readjustments are instituted as are favorable to great feats of strength or endurance—for fight or flight. According to Cannon's view, then, adrenalin is a chemical agent which cooperates with nervous factors in helping the body meet the emergencies of existence

Removal of the adrenal cortex results in death in the case of man or such animals as the dog or cat But injections of cortical extracts will keep such animals alive A serious malady in man known as Addison's disease, characterized externally by bronzing or pigmentation of the skin, is associated with pathological changes in the adrenal cortex Such patients, however, show improvement following injections of cortical extracts.

So far no specific secretion has ever been definitely isolated from the cortex, and its functions are therefore not so well understood as those of the medulla Inasmuch as cortical enlargement (hypertrophy) has been found to be associated with precocious sexual development it is inferred that one of its functions is concerned with determining and controlling sexual maturity Overactivity of the adrenal cortex apparently causes marked accentuation of the masculine traits Women so affected acquire masculine characters, such as beard, deep voice and coarse features Cortical tumors have apparently caused even young children to develop the sexual characteristics of the adult Some bits of evidence indicate that the cortical secretion serves also to neutralize certain poisonous products of protein metabolism

It has long been known that the generative glands (gonads) besides forming germ-cells also produce internal secretions which influence the individual profoundly, both mentally and physically These secretions are indispensable for the proper development of the specific male and female characteristics Much experimentation has been in progress with the lower animals in this connection in recent years and many interesting facts determined In certain mammals such as the rat or guinea-pig, for instance, if the ovaries of a female are transplanted into a male which has been previously unsexed, the latter under stimulus of the ovarian secretions assumes a behavior like that of the female Its hair and skeleton come to resemble more those of the female than of the male, and its rudimentary milk glands become enlarged to functional size

If the ovary of a mallard duck is completely removed, at the succeeding moult she takes on the very different plumage of the male. Likewise, if the ovaries are removed from very young hens they develop to a greater or lesser degree the more ornate plumage, the spurs, wattles, comb and larger size of the cock. The development of these characteristics will be still further increased if extract of the male gonad is injected, or if the gland itself is transplanted to such castrates.

A remarkable experiment which reveals the importance of the sex hormone in sex differentiation has been discovered by Professor F R Lillie in his study of the "free-martin," a sterile female calf born as a twin to a male calf. In cattle when twins, one male, the other female, arise, the blood-vessels in the fetal membranes of the two embryos may fuse in such a way that their blood intermingles The male gonads develop ahead of those of the female with the result, according to Professor Lillie, that the male sex hormone is the first to pass into the joined circulatory systems It interferes with the growth of the ovary in the female, causing sterility and modifying more or less profoundly various of her secondary sexual characters so that they tend to assume the male condition Witschi has shown that such a male influence is also exerted when tadpoles are grafted together in pairs, the females attached to a male being made masculine Burns has shown that if salamander tadpoles are grafted together in pairs, when the individuals happen to be of different sex the sex hormones of the one—sometimes the female, sometimes the male—are likely to alter profoundly the sexual system of the other

In the female of the vertebrates, at least, the rhythmical occurrence of ovulation is correlated with rhythmical changes in the secretions of the ovary. In mammals the hormones so far identified with the ovary have been derived from two sources, namely, the follicular fluid which surrounds the egg before it is shed from the ovary and the corpus luteum, a yellowish mass of cells which come to fill the ruptured follicle after the egg has been discharged The follicular extracts differ decidedly in function from those of the corpus luteum, although there appears to be a reciprocal or supplementary relationship between them The corpus luteum increases in size for a time and then undergoes retrogressive changes and is finally absorbed The duration of this growth period depends upon whether or not the discharged ovum has been fertilized and is developing in the uterus If such development is in progress the corpus luteum increases in size, becoming what is known as the corpus luteum of pregnancy, it persists for a considerable time, depending upon the length of gestation If development of the embryo is not taking place in the uterus, the corpus luteum disappears shortly and a new follicle gradually accumulates liquid, projects from the ovarian surface and at the proper interval discharges another ovum. Thus the cycle of ovulation (oestrous cycle) is repeated rhythmically unless interrupted by pregnancy There are indications, however, that the hormone from the anterior lobe of the pituitary body has some part in stimulating the ovary to renewed ovulation. Not only periodic changes in the ovary itself but in the uterus, mammary glands and other parts of the body are brought about through the agency of the ovarian hormones Allen and Doisey have succeeded in preparing a hormone from follicular liquid which restores the normal mating instincts and the characteristic sex cycle in rats and mice in which these had been lost as a result of removal of the ovaries This extract, when used on young animals immediately after weaning, induces precocious sexual maturity Not only will follicular hormone when repeatedly injected cause development of the mammary glands in females from which the ovaries have been removed but it will likewise stimulate the mammary glands of males to develop A similar hormone has been obtained from placental tissue and the amniotic fluid which surrounds the developing fetus, also from the urine of pregnant cows and pregnant women

The corpus luteum hormone seems to have as one of its functions the preparation of the uterine wall for implantation of the fertilized ovum, for if the corpora lutea are destroyed implantation does not occur Hisaw has shown, however, that what he calls a "one, two" reaction is involved—that the uterine mucosa must first be sensitized by the follicular hormone before the corpus luteum extract is effective On the other hand, injection of follicular hormone following implantation will cause abortion Hisaw has also isolated from ovarian extracts a crystalline product which he terms a "relaxative hormone" because it relaxes the pubic symphysis before parturition and thus facilitates bearing the young That it is not the only hormone of the corpus luteum is shown by the fact that the non-crystalline residue left after removal of the relaxative hormone still retains the other endocrinal functions of corpus luteum extract Hisaw has recovered this relaxative hormone also from the placenta and from the blood and the urine of various pregnant mammals, including human beings The corpora lutea of pregnancy also apparently supply a hormone which inhibits ovulation during pregnancy and which stimulates the development of the mammary glands

As regards the internal secretions of the testes Moore has succeeded in isolating testicular extracts which when repeatedly injected into castrated males restores all the characteristic masculine behavior and structures except the gonads themselves It is commonly believed that the internal secretion of the testes is furnished by so-called interstitial cells which lie outside the tubules which produce the germ-cells, inasmuch as the latter can be caused to atrophy while the interstitial cells remain unaffected and the animal yet develop or maintain its normal sexual characteristics.

The great importance of endocrine glands in controlling the later development of vertebrates, particularly the rôle they may play in determining the conformations of various parts of the body, opens up the important issue of how much such similarities are to be attributed to direct heredity, how much to endocrinal activities Certain types of defectives, such as cretins and so-called Mongoloids, even when of different races, often show marked resemblances The abnormalities in the case of cretins are ascribed to endocrine—particularly to thyroid-deficiency in the affected individual—and those of the Mongoloids are supposedly the result of endocrine disturbances in the mother or to fetal nutritive insufficiency The Mongolian facial type, however, is also prevalent in cretins and may result from insufficiency of thyroid secretion during the growth period, since such lack is known to have a characteristic effect on the bones of the nose and the base of the skull Thyroid as well as pituitary insufficiency may also be an important factor in dwarfing From the standpoint of heredity, therefore, a peculiarity in a particular structure might have its immediate determining cause in the output of an endocrine gland, but if inheritance is involved, the determining genes would be those responsible for the changed condition of the gland in question, not for the visible, finished trait

That all such developmental anomalies can not be attributed wholly to improper functioning of some endocrine gland of the affected individual, however, is shown by the fact that certain of them reveal their presence far back in the early fetus before its endocrine glands are functional This is true, for example, of the achondroplastic dwarf, characterized by abnormally short and somewhat twisted arms and legs, with head and trunk of approximately normal size Such individuals have many of the evidences—disproportionately broad face, low nose-bridge, overhanging forehead, undershot jaw—of thyroid deficiency. This abnormality, furthermore, can not be attributed, in all cases at least, to endocrinal defects of the mother, since pedigree tabulations are known which clearly show that the condition can be transmitted from the paternal side Such a characteristic shaping-up of the head and face is due to lack of growth of the skull base Professor Stockard points out the resemblance of this condition in man to that found in certain breeds of the lower animals such as the bulldog and the pug-dog, and maintains that the underlying cause is probably the same in each He believes, from our knowledge of their inheritance and development, that the primary cause lies in a germinal mutation or sport and that the endocrinal effects are secondary.

The English anatomist Keith is inclined to regard the primary differences which mark off the races of man as due to the relative activities of various endocrine glands. While his opinions are highly conjectural they are suggestive and show the importance of further investigation in this interesting field. Stature, for example, is largely regulated by the secretion from the pituitary gland, and Keith maintains that the average European is taller than the average Negro or Mongolian because of the more pronounced activity of this gland in the Caucasian type. The pituitary also probably influences the character of the hair, the texture of the skin, and the cast of features. Hormones from the male gonad are apparently responsible for the main secondary sexual differences. Judging from the more heavily haired condition of the body in Caucasians, he likewise infers that this tissue is more active in them than in the Mongolian and Negroid types. Again, he thinks that the lighter color of the paler-skinned races may have been produced by a greater activity of the adrenal glands, since their secretion tends to destroy pigmentary bodies. According to his hypothesis, then, the Caucasian type is characterized by a relatively greater amount of internal secretion from gonads, and from pituitary, thyroid and adrenal glands. Since racial characteristics are inherited, however, it is evident that such differences of mind or body, in so far as they are referable to the influence of internal secretions, must be assigned eventually to the germinal factors which determine the corresponding differences in the endocrinal glands.

In conclusion, then, I think it is evident from even this cursory review of the endocrine system that we have in the internal secretions a series of powerful agents which profoundly influence our body-structure, our health and our whole personality.

SCIENTIFIC EVENTS

DROUGHT IN THE NESTING AREAS OF WATERFOWL OF THE UNITED STATES AND CANADA

THE reports of representatives of the U. S. Biological Survey who have recently returned from expeditions to northern areas of the United States in company with Canadian officials to the principal duck-breeding areas in Canada indicate that severe limitation of the number of waterfowl to be killed during the coming season may be necessary as a result of long-continued drought in the nesting areas. Although federal regulations governing the shooting of ducks and geese were recently amended to reduce the open season throughout the United States by two weeks this fall and winter, still further restriction of the annual kill may be necessary.

Discouraging reports were made of unprecedented drought, of lakes and ponds and marshes turned into dusty barrens with no sign of aquatic life, and of the almost complete absence of water during the period in the great prairie breeding grounds of southwestern Manitoba, southern Saskatchewan as far north as Saskatoon, and Alberta westward to the foothills of the Rocky Mountains and northward to the vicinity of Edmonton.

A marked shortage of breeding ducks and young was noted in the great delta region of the Peace and Athabaska rivers. In tours of several thousand miles the investigators saw only a few dozen small broods of young ducks in an area that in normal years has produced many millions of mallards, pintails, redheads, canvasbacks, bluebills and teals.

The shallow prairie sloughs and lakes of the region have disappeared following about ten years of reduced rainfall and three seasons of persistent drought. A far-reaching inquiry sent out by the Canadian Government has failed so far to show that the ducks have found other more remote breeding areas.

Not all the ducks and geese that come into the United States are bred in the region surveyed but a very large proportion of the wild fowl that make up the great flights know that country as their birthplace, and the shortage of breeding birds and the loss of so many young will have a serious effect upon shooting conditions both in this country and in Canada. Both the Canadian and United States governments under the migratory-bird treaty are concerned over the disastrous conditions that now threaten the wild fowl of the continent.

The two governments are therefore endeavoring to avert shortages by devising methods for saving an adequate supply of breeders for next season. The severity of the limitations that may be necessary will not be determined definitely until after further conferences between the authorities of Canada and of the United States and until more information is received from the nesting grounds.

To avert the grave possibilities of a permanent disaster to the wild fowl, the gunners in all sections of both countries will probably be asked to reduce their duck shooting this winter to a minimum, so that enough mature birds will survive to breed and thus enable the flocks to replenish themselves with the return of water to the parched areas.

THE INTERNATIONAL PASSAMAQUODDY FISHERIES COMMISSION

THE first members of the scientific staff appointed to investigate the Passamaquoddy fisheries for the

Canadian and American governments have arrived at St. Andrews and are preparing to institute work immediately. The object of the investigation will be to study the probable effect of the international development to generate electric power from the movement of tides in Passamaquoddy Bay and in Cobscook Bay on the fisheries of that region

A joint meeting of the International Passamaquoddy Fisheries Commission and the advisory committee took place at the Atlantic Biological Station on July 10 at which the program was considered

President Hoover has appointed Mr Henry O'Malley, commissioner of fisheries, and Mr O E Sette, in charge of the North Atlantic fishery investigations, as United States commissioners to conduct the investigation The Honorable W A. Found, deputy minister of fisheries, and Professor A. G Huntsman, of the Biological Board of Canada, have been appointed to represent Canada in this investigation.

At a meeting of the commission in Montreal on June 8, to consider arrangements for starting the investigation, Mr Found was chosen chairman of the commission, and it was decided that four experienced investigators should be selected to conduct investigations on zooplankton, phytoplankton, oceanic chemistry, and physical oceanography and fisheries Dr Charles J Fish, director of the Museum of Science, Buffalo, New York, was selected biologist in charge of zooplankton and executive secretary to the investigative staff Through the courtesy of the Buffalo Museum, Dr Fish has been granted leave of absence for this work, and he is now engaged in organizing the investigation and securing subordinate personnel Dr E. E Watson, of Queens University, Kingston, Ontario, a hydrographer with previous experience in local waters, has been appointed to take charge of the investigation in physical oceanography Headquarters have been established at the Atlantic Biological Station at St Andrews, New Brunswick

The commission, and its investigative staff, has the assistance of an advisory committee, which consists of two competent scientific representatives from each country. Professor F. R Hayes, of the zoological department of Dalhousie University, and Dr A W. H. Needler, in charge of the oyster investigations for the biological board, represent Canada. Dr. H B Bigelow, director of the Woods Hole Oceanographic Institution, and Professor A. E. Parr, curator of the Bingham Oceanographic Collection, Yale University, represent the United States.

Conclusions have previously been reached that the soundest basis for forecasting the probable effects of the dam upon the fisheries of this region would likely be investigations along the following lines:

(1) Detailed study of the occurrence of the herring in relation to various environmental conditions as an indication of how its availability in the fishery might be affected by the construction of the dams

(2) The study of the abundance of phytoplankton and zooplankton (as a basis of fish life) in relation to the physical and chemical states of the water in the Bay of Fundy and along the coast of Maine

(3) Detailed examination of existing hydrographic conditions as indicating the relative importance of the water-mixing at the mouth of the Passamaquoddy Bay as determining the physical and chemical states of the water in the Bay of Fundy and along the coast of Maine

Two vessels have been loaned for use by the commission The *Prince,* which in the past has been utilized by the Biological Board of Canada at St Andrews, has been assigned to the new investigation and at the present time is being outfitted The second vessel, the *Pelican,* recently constructed for the U. S Bureau of Fisheries, will shortly leave Boothbay Harbor, Maine, and is expected to arrive in about a week's time Active field work will for the time being be carried on by Dr Fish and Dr Watson. It is expected that additional members of the scientific staff will be announced later

THE FARADAY CELEBRATION

THE celebration of the hundredth anniversary of the discovery of electro-magnetic induction by Michael Faraday will take place from September 21 to 23 at the Royal Institution of Great Britain where the experiment was made that has transformed our civilization.

Arrangements are being made for the welcome and entertainment of the delegates and guests beginning on Saturday, September 19. Officers of the Royal Institution, with interpreters and guides, will be in attendance to welcome arriving delegates and guests, and to afford any help that may be required Ladies accompanying delegates and guests will be welcomed and entertained by members of a Ladies' Committee which has been formed for the purpose Visits to places of interest have been arranged on each day of the celebration By the courtesy of the general officers of the British Association for the Advancement of Science, delegates and foreign guests at the Faraday celebrations who are not already members of the association will receive complimentary tickets for its centenary meeting

On Monday, September 21, there will be an informal meeting in the lecture theater of the Royal Institution where a statement regarding the program in English, French and German will be made. In the afternoon a reception for the delegates will be held in the lecture theater by the president and managers of the institution. A Faraday commemorative meeting will take place at the Queen's Hall, Langham Place, in the evening, when short speeches will be made by distinguished representatives of institutions in various parts of the world Music will be rendered by the Symphony Orchestra of the British Broadcasting Corporation, under the direction of Sir Henry Wood, and the proceedings will be broadcast On Tuesday morning, September 22, there will be a conference at Kingsway Hall, at the Institution of Electrical Engineers A conversazione will be held at the Royal Institution and at the Institution of Electrical Engineers at the Royal Albert Hall in the evening

A private view of the Faraday Exhibition at the Royal Albert Hall will be extended to delegates and visitors on Wednesday morning, September 23 There will be a garden party at the National Physical Laboratory, by invitation of the director, Sir Joseph Tetavel, on September 24 The British Association Centenary Meeting will include a reception of British Association delegates in the Royal Albert Hall The Faraday Exhibition will be opened to the public by the president of the British Association, the Right Honorable J C Smuts, later in the afternoon In the evening the presidential address to the British Association will be given by General Smuts, at the Central Hall, in Westminster

THE JOSEPH HENRY LECTURESHIP OF THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE Philosophical Society of Washington, through its General Committee, has decided to establish a lectureship in honor of its first president, Joseph Henry, Such action at this time is particularly appropriate, since 1931 is the centenary of the discovery of electromagnetic induction, a discovery which has brought honor not only to Henry, but also to Faraday The purpose and scope of the lectureship can best be shown by quoting the report of the special committee which was adopted by the General Committee·

(1) There is at present in the hands of the treasurer a cash balance and the committee is in agreement that . a portion of it be spent . in some way which will advance the cause of science and reflect credit on the society

(2) It is proposed that at suitable intervals of time a speaker be selected to address the society on one of the broad aspects of some field of science, the speaker to review the recent developments or present status of a subject included in or related to the physical sciences

(3) It is further proposed that the complete address be put in form for publication and submitted to the *Journal* of the Washington Academy of Sciences

(4) It is further proposed that the aforementioned address shall be called the Joseph Henry Lecture in memory of the first president of the Philosophical Society

(5) It is further proposed that the first Joseph Henry Lecture be delivered before the society in the fall of 1931, and that thereafter the lecture shall be delivered annually before the society in the spring of the year starting in the spring of 1932

(6) It is further proposed that the expenses of the speaker incidental to a visit to Washington shall be borne by the society and that in addition an honorarium of one hundred dollars ($100) shall be presented to the lecturer at a suitable time during his visit

(7) The complete arrangements for any one meeting are to be made by a special committee of three who are to be responsible for selecting the speaker and securing the manuscript in form for publication. No member of the committee should have been a member of the immediately preceding similar committee

The general committee further provided that the special committee for a given year shall be appointed before October 15 of the preceding year In accordance with this action, the following committees have been appointed

For the year 1931 C G Abbot, L H Adams, *chairman*, R E Gibson For the year 1932 L J Briggs, *chairman*, J. H Taylor, F E Wright

H L CURTIS,
President
L V JUDSON,
Corresponding Secretary

SCIENTIFIC NOTES AND NEWS

ON the occasion of the centenary meeting of the British Association, which will be held in London in September, the senate of the University of London has decided to confer the degree of doctor of science *honoris causa* on the president, General J. C Smuts, on Professor Sir F Gowland Hopkins, president of the Royal Society, and on three former presidents of the Royal Society, Lord Rutherford, Sir Charles Scott Sherrington and Sir Joseph J Thomson.

THE *Journal* of the American Medical Association states that plans are under way to ask Americans to contribute to a million shilling fund recently started in England as a tribute to Sir Ronald Ross, discoverer of the rôle of the mosquito in the transmission of malaria Dr Robert L. Pitfield, Philadelphia, is secretary of the Ross Award Fund of America and will receive checks at his address, 5211 Wayne Avenue, Germantown, Pennsylvania. In addition to Dr Pitfield, American trustees of the fund are Drs. Thomas McCrae, Joseph McFarland, Francis R. Packard, Damaso de Rivas, Victor Robinson, Theobald Smith and Frederick L Hoffman.

THE Roerich Museum has announced the recent election of Professor Chandrasekhara V. Raman, professor of physics at the University of Calcutta, and recipient of a Nobel prize, Professor S I Metalnikoff, of the Pasteur Institute, and Dr E D Merrill, director-in-chief of the New York Botanical Gardens, as honorary advisers of the museum

DR HOWARD McCLENAHAN, secretary of the Franklin Institute, has been elected an honorary member of the Royal Institution of Great Britain The diploma of honorary membership will be formally presented to him at the Faraday Celebration in September Dr McClenahan will remain abroad for some time to visit the principal museums of industry and physical science of Europe in order to plan equipment and exhibitions for the new Franklin Memorial and the Franklin Institute Museum

MR EDWARD BAUSCH, president of the Bausch and Lomb Optical Company, was awarded the honorary degree of doctor of laws by the University of Rochester at its recent commencement exercises The award was made in recognition of Mr Bausch's "noteworthy contribution to optical science in connection with the provision of optical instruments of highest quality for industrial and scientific research"

DR HOWARD HUNTER CRAVER, director of the chemical division of the Pittsburgh, Pennsylvania, Testing Laboratory, and editor of *The Crucible*, was presented with a gold watch at a dinner preceding a recent meeting of the Pittsburgh section of the American Chemical Society. The watch was given as a token of esteem and appreciation of his services to the Pittsburgh section of the society Mr E E Marbaker made the presentation speech

HONORARY doctorates have been conferred by the Institute of Technology at Hannover on Dr Friedrich Paschen, director of the Physikalisch-Technische Reichsanstalt, Berlin, and on Dr Hans Stille, professor of geology and paleontology at Gottingen

THE University of Geneva has awarded its doctorate *honoris causa* to M Henry Correvon, an expert in Alpine plants and the designer of many Alpine gardens in Switzerland and in England

AN informal meeting was held at the British Museum on July 11, presided over by the Archbishop of Canterbury, at which a bronze bust was presented to Sir Frederic Kenyon, director of the museum and principal librarian, in recognition of his work for the museum during a period of forty-two years

FOUR new appointments to the staff of the New York Hospital-Cornell Medical College Association's Center, which will open in September, 1932, are announced by Dr G Canby Robinson, its director The appointments are made a year in advance to enable the men to study the new laboratories and direct their equipment and plan the organization of their departments The appointments include Dr Eugene L Opie, as professor of pathology of the Medical College and pathologist to the hospital, Dr Herbert S. Gasser, as professor of physiology, Dr George S Amsden, as professor of psychiatry and psychiatrist-in-chief of the hospital, and Dr James M Neill, as professor of bacteriology and immunology Professor Opie, now professor at the University of Pennsylvania, succeeds Dr James Ewing, who will retire as head of the department of pathology after thirty years of teaching in Cornell He will devote his time to a study of cancer and the problems of the Memorial Hospital, of which he is president of the medical board Dr Gasser, now professor of pharmacology in the Medical School of Washington University, St Louis, succeeds Dr Graham Lusk, who will retire from the Cornell faculty in 1932 after forty years of teaching Dr Neill, who is professor of bacteriology at Vanderbilt University School of Medicine, succeeds Dr William J Elser, who will continue as head of the department of applied pathology and bacteriology Dr Amsden will open the new department of psychiatry with Dr William L Russell

DR CHARLES E SPEARMAN, professor of psychology at University College, London, will retire at the end of the coming academic year, when he will have passed the age of sixty-eight years Dr Cyril L. Burt, of the London Day Training College, has been appointed to succeed Dr Spearman

DR FRANCIS BAYARD CARTER has been appointed professor of obstetrics and gynecology at the Duke University School of Medicine Dr Edwin C Hamblen has been appointed associate professor in the department

DR HOWARD H BEARD, assistant professor of biochemistry in the Western Reserve University School of Medicine, has been appointed professor of biochemistry at the Louisiana State University School of Medicine.

DR. JOHN H PARKER, of the Kansas State Agricultural College, has been appointed acting professor of plant breeding for the year 1931–32 at Cornell University to take the place of Dr H H Love, who is on leave of absence

DR GERHARD FUNKHAUSER, formerly of the faculty of the University of Berne and more recently research fellow on the Rockefeller Foundation at the University of Chicago and at Yale University, has been appointed assistant professor in the department of biology of Princeton University.

Dr. Raymond E. Murphy has been appointed economic geographer in the school of mineral industries of the Pennsylvania State College

Dr. Burt P. Johnson, of the University of Wisconsin, will spend next year investigating virus diseases of plants at the Citrus Experiment Station of the University of California. Dr Johnson holds a fellowship of the National Research Council and has been research assistant to Dr B M Duggar for the past three years

Mr Alexander B Klots, of Cornell University, has accepted a position with Ward's Natural Science Establishment as head of the entomological department He will also be an associate in entomology at the University of Rochester

Dr Waldo S Glock, of the Ohio State University, has been appointed by the Carnegie Institution of Washington for the year beginning July 1, 1931, as a full-time assistant to Dr A. E Douglass, of the Steward Observatory at the University of Arizona, in connection with the work of Dr Douglass as a research associate of the Carnegie Institution on studies of tree growth and climatic cycles

Dr. T J Drakeley, since 1919 head of the department of chemistry and of the school of rubber technology at the Northern Polytechnic Institute, London, has been appointed principal of the institute to succeed Dr R S Clay, who will resign on January 1 after serving for twenty-nine years.

Dr. A Murray Drennan, present professor of pathology in Queen's University, Belfast, has been appointed professor of pathology in the University of Edinburgh

Dr. John F V Phillips, who until recently was engaged in ecological research on the tsetse fly problem in Tanganyika Territory, British East Africa, has accepted the position of professor of botany at the University of Witwatersrand, Johannesburg, South Africa

Dr. Richard Wagner, professor of physiology at the University of Graz, has been called to the University of Freiburg im Breisgau

Dr. A. E Longley, botanist of the U S Department of Agriculture, will spend several months at the Scripps Institution of Oceanography making special investigations at the acclimatization station of the department.

Mr. Foster H. Benjamin, who was for some years assistant to Dr Barnes at Decatur, Illinois, has been transferred to the U. S. Bureau of Entomology and assigned to a position in the National Museum where he will devote most of his time to identification work on North American Lepidoptera. Mr. Benjamin has been for the last three years engaged in work on the Mexican orange worms and the Mediterranean fruit fly for the Plant Quarantine and Control Administration of the U S Department of Agriculture.

Professor Arthur H. Compton, of the University of Chicago, will during September continue his investigations on the penetrating power and effects of the cosmos rays in the mountains and canyons of Colorado Dr Joyce C. Stearns, professor of physics at the University of Denver, is in charge of the expedition, which includes several selected students from both universities The undertaking is sponsored by the two universities. Members of the expedition will climb Mount Evans, one of the highest Colorado peaks, and will take measurements from this altitude. They will go to Grand Lake to make use of the snow water at a high altitude.

The British Colonial Office has issued a statement on a Conference of Colonial Directors and Deputy Directors of Agriculture, which was held in London recently to discuss administrative problems in their respective colonies The conference was opened by the Secretary for the Colonies, and met, normally, under the chairmanship of his agricultural adviser, Mr F A Stockdale Among those present were the directors of agriculture of Malaya, Kenya and Nigeria, and the principal and commissioner of agriculture of the Imperial College of Tropical Agriculture in Trinidad. The questions discussed related rather to the administration of the agricultural departments than to the technicalities of agricultural research and experimentation The conference recorded its appreciation of the high standard that has been attained in the training of agricultural officers, and emphasized the necessity for the continuance of the scholarship scheme Certain suggestions were put forward for the extension of the training now given to the majority of scholars at Cambridge and at the Imperial College of Tropical Agriculture in Trinidad, especially in regard to the economic aspects of agriculture

Dr. Umma Shuma Sharga has recently arrived at Cornell University from the University of Edinburgh to study entomological control methods in this country before returning to India. He will remain in Ithaca about a year.

The annual meeting of the American Psychological Association will be held from September 10 to 12 at University College, Toronto. Dr Walter S. Hunter will deliver the presidential address on "The Psychological Study of Behavior" on Friday, September 11.

The autumn convention of the Electrochemical Society will be held in Salt Lake City, Utah, from September 2 to 5. Dr. Duncan MacRae, of the Edgewood Arsenal, is chairman of the local committee. The headquarters of the meeting will be at Lord Baltimore Hotel. Plans are under way for the sixty-first annual convention of the society to be held in Baltimore from April 21 to 23 in 1932.

The sixteenth annual meeting of the Optical Society of America will be held at Rochester, New York, from October 22 to 24. In addition to the usual program of papers contributed by members on their own initiative, the meeting will include the following special features: (1) A session devoted to invited papers on "Aerial Photographic Mapping", (2) a session devoted to invited papers on "Optical Problems in the Motion Picture Industry", (3) a dinner at the plant of the Bausch and Lomb Optical Company followed by an exhibit illustrating operations of the plant and also some optical phenomena not often seen; (4) the annual society dinner followed by a trip to the University of Rochester to see the new buildings, and (5) the presentation of the Frederic Ives Medal for 1931. Sessions will be held at the Hotel Sagamore, in the auditorium of the new Research Laboratory of the Eastman Kodak Company, and in the Physics Building at the University of Rochester.

The *Journal* of the American Medical Association announces that the second International Congress of Comparative Pathology will be held in Paris from October 14 to 18, under the chairmanship of Professor Achard, general secretary of the Academy of Medicine. The official topics on the program are "Vaccination against Tuberculosis," Professor Calmette, Professor Gerlach, of Vienna, Professor Kfouri, "Brucella Infections in Man and Animals," Van der Hoeden, of Utrecht, Martin Kristensen, of Copenhagen, Oluf Bang, of Copenhagen; "Milk as a Pathogenic Agent," Drs. Lesne, Porcher and Tapernoux, of Lyons, Rowel, of Quebec; "Mineral Deficiencies," Simonnet and Randoin, Dr. Sjollema, of Utrecht, H. B. Humphrey, of Washington, D. C., Jacob Eriksson, of Stockholm, Kotte, of Freiburg im Breisgau; "Ultraviruses," Dr. Handuroy, Professor Fln, of Leyden, Quanjer of Wageningen, Gussow, Canada, and von Brehmer, of Berlin; "Helminthiasis," Professor Joyeux, of Marseilles, and Baer, Stevenel and Lerroux; "Psittacosis," Professor Verge, of Alfort; "Anaphylaxis," Professor L. K. Wolff, of Utrecht; Professor D. Storm van Leuwen, of Leyden, Dr. Koeppenberg, of Groningen.

Industrial and Engineering Chemistry states that the first congress of the new International Association for the Testing of Materials will be held this year, from September 6 to 12, in Zurich, Switzerland, in the buildings of the Swiss Federal Polytechnicum. The association consists of individuals and companies in the various countries. In the United States, the national association through which contacts are established is the American Society for Testing Materials, and many of its members belong to the international body. The objects of the association are to secure international cooperation and the exchange of views and experience on all matters connected with the testing of materials. The chief means of securing this result is the holding of periodical international congresses at intervals of from three to five years. The work does not involve standardization of materials, which is one of the chief functions of the American Society for Testing Materials.

Specific bequests of more than $175,000 were made in the will of Dr. Richard Alexander Fullerton Penrose, Jr., who left the residue of his estate, valued at $100,000 to Western Reserve University, $50,000 to and the Geological Society of America. The two societies named in the will "are to receive the bulk of the estate in equal parts. The bequests are made in the form of endowment funds and only the income is to be used by the societies." The University of Chicago receives $50,000 to be used for the benefit of *The Journal of Geology,* of which Dr. Penrose was one of the editors for many years. The Economic Geology Publishing Company, incorporated in the District of Columbia, is given $25,000 to be used for the benefit of its journal.

The will of the late Worcester R. Warner, president of the Warner and Swasey Company, bequeaths $100,000 to Western Reserve University, $50,000 to the Syrian Protestant College at Beirut, and $25,000 each to the American Society of Mechanical Engineers and to the Doshisha College at Kyoto, Japan.

Jacob F. Schoellkopf, of Buffalo, has founded a gold medal to be awarded annually to some chemist in recognition of unusual research in chemistry. It will be presented for the first time at the eighty-second annual convention of the American Chemical Society which meets in Buffalo from August 31 to September 4.

A correspondent writes: "The 69-inch reflector for the Perkins Observatory of the Ohio Wesleyan University has reached the final stages of figuring at the optical works of the J. W. Fecker Company, Pittsburgh. The Foucault knife-edge test at the center of curvature exhibits an extraordinarily satisfactory response with temperature changes indicating the excellent quality of the glass which was poured in the research optical shops of the Bureau of Standards three years ago"

THE *Journal* of the American Medical Association states that a new department of preventive medicine has been established at Tulane University of Louisiana School of Medicine, New Orleans, as the result of an arrangement with the Commonwealth Fund of New York through which the university will participate in the rural health program recently initiated in Mississippi by the fund An annual appropriation of $25,000 has been allotted by the fund to the school of medicine to establish the new department and to encourage attention to preventive medicine in other clinical departments Five free scholarships have been established for undergraduate medical students from Mississippi, providing the student with $1,200 a year for four years, with the requirement that after graduation he shall practice at least three years in Mississippi In addition, fifteen practicing physicians will be sent each year to Tulane for four months' graduate work. Their tuition and transportation to and from New Orleans will be paid by the fund and they will be allowed a monthly stipend of $250 Dr William Harvey Perkins is head of the new department The arrangement with Tulane is similar to that made recently with the Harvard University Medical School for practitioners of Massachusetts

THE Forest Service of the U S. Department of Agriculture has announced an addition of 16,558 acres of forest land to the national forest area in the Eastern, Southern and Lake states The National Forest Reservation Commission has approved an expenditure of $52,624 for the purchase of this land The land acquired will be added to the national forest purchase units which are already protected and administered by the Forest Service for continuous development of forest resources and to safeguard watershed values

DISCUSSION

THE UNCERTAINTY PRINCIPLE AND FREE WILL

IN his very excellent presentation of the uncertainty principle, published in a recent number of SCIENCE,[1] Professor Darwin concludes with a comment regarding the significance of this principle in connection with the problem of "free will," which should not be allowed to pass without comment. He may be correct in his view that "the question is a philosophic one outside the thought of physics" Yet the reason that he offers to show that the uncertainty principle does not help to free us from the bonds of determinism is inadequate

Darwin's argument is that "physical theory confidently predicts that the millions of millions of electrons concerned in matter-in-bulk will behave . . . regularly, and that to find a case of noticeable departure from the average we should have to wait for a period of time quite fantastically longer than the estimated age of the universe" He apparently overlooks the fact that there is a type of large-scale event which is erratic because of the very irregularities with which the uncertainty principle is concerned. I refer to those events which depend at some stage upon the outcome of a small-scale event.

As a purely physical example, one might pass a ray of light through a pair of slits which will so diffract it that there is an equal chance for a photon to enter either of two photoelectric cells. By means of suitable amplifiers it may be arranged that if the first photon enters cell A, a stick of dynamite will be exploded (or any other large-scale event performed); if the first photon enters cell B a switch will be opened which will prevent the dynamite from being exploded What then will be the effect of passing the ray of light through the slits? The chances are even whether or not the explosion will occur That is, the result is unpredictable from the physical conditions

Professor Ralph Lillie has pointed out[2] that the nervous system of a living organism likewise acts as an amplifier, such that the actions of the organism depend upon events on so small a scale that they are appreciably subject to Heisenberg uncertainty This implies that the actions of a living organism can not be predicted definitely on the basis of its physical conditions

Of course this does not necessarily mean that the living organism is free to determine its own actions The uncertainty involved may merely correspond to the organism's lack of skill Yet it does mean that living organisms are not subject to physical determinism of the kind indicated by Darwin.

ARTHUR H. COMPTON

UNIVERSITY OF CHICAGO

GEOMORPHIC NOMENCLATURE

IN any progressive branch of science there arrives a time when the nomenclature adopted in the early stages of that science becomes inadequate, either because of inaccurate usage or because of insufficiency in the light of growing conceptions, or for both reasons. This phenomenon is exemplified in the history and present needs of geomorphic nomenclature.

---

[1] C G Darwin, SCIENCE, 73, 653, June 19, 1931

[2] Ralph Lillie, SCIENCE, 66, 139, 1927. Lillie draws much the same conclusion as that found here.

When the conception and the word, peneplain, were simultaneously introduced by the American founder of geomorphic science, Professor William M. Davis,[1] the conception, which this word was manifestly intended to cover, was the land form produced in the penultimate stage of the erosion cycle, the approximate completion of a cycle of erosion over great areas and on large land masses.

Further study of land forms long ago revealed the truth that cycles of erosion are not all of like duration, they may be terminated at any point of progress toward ultimate completion. Where traces of the forms produced in these earlier stages have been preserved, geomorphologists have been content to call them partial peneplains, and more immature forms of still earlier stages have been called terraces or, more recently, straths.

Terrace is too useful a term in its unrestricted meaning to be withdrawn for such a limited and technical use. Strath is defined in the Standard Dictionary as follows: "(Scot.) A wide open valley, usually a river course, distinguished from a glen." This has been its usage by Geikie in "Scenery of Scotland" (p. 156). It is scarcely admissible to use with a new significance a geomorphic term which has a prior and different usage in Great Britain, namely, to designate the broad valley floor unrejuvenated. Several years ago the writer, feeling keenly the need of a term that should not put limitations on so useful a word as terrace (or as bench) and that might be given a restricted technical significance, approached M. R. Campbell and Laurence LaForge of the U. S. Geological Survey for suggestions. The discussion that ensued resulted in the selection of the word *berm*.

Berm is defined in the Standard Dictionary as follows: "*Civ. Eng.* A horizontal ledge part way up a slope, bench. *Fort.* A narrow level space at the outside foot of a parapet, to retain material which might otherwise fall from the slope into the ditch." It is suggested that this term be given a geomorphic usage, it should be used to distinguish those terraces which originate from the interruption of an erosion cycle with rejuvenation of a stream in the mature stage of its development. Dissection, following upon elevation of the land, will leave remnants of the earlier broad valley floor of the rejuvenated stream as a terrace, or berm, and remnants of the uplifted abrasion platform as a seaward-facing terrace, or berm. In different localities every gradation between relatively narrow berms and widely developed peneplains may occur. Considerable latitude should be given therefore in the use of this term, so that it may include berm-like forms as well as typical berms, while those forms more nearly approaching the peneplain might be called partial peneplains.

Such a distinction as the following between berms, partial peneplains and peneplains might be considered: berms, paralleling streams and sea-coast, only cross divides on weak formations, partial peneplains cross divides on rocks of median resistance or on decayed resistant rocks, peneplains are wide-spread on resistant as well as non-resistant rocks.

F. Bascom

U. S. Geological Survey,
Washington, D. C.

LORD KELVIN'S "MORTAL SPRING"

When I began the study of the calculus, using Church's "Elements of the Differential and Integral Calculus," I was greatly bewildered by the reasoning leading to the central principle of the subject, the differential coefficient, latterly the derivative. How a quantity, dx, for example, could be something in the first member of the equation and nothing in the second was a great mystery, and the statement that such was the fact came as something of a shock to one who had begun to associate clarity and rigor with all mathematical processes. It looked, to a novice, suspiciously like smuggling approximation methods into a territory where exactitude alone is permissible.

Since Newton was one of the founders of the calculus I turned to him for light, and examined with care his method of passing, using present-day symbols, from $\frac{\Delta y}{\Delta x}$ to $\frac{dy}{dx}$. After considerable labor I was forced to the conclusion that the passage was made by a flash of intuition, and not by so-called logical rigor. His mind had been prepared, of course, for this great insight by deep and long-continued reflection upon the behavior of variable magnitude. This helped me out, for what was good enough for Newton should, surely, be good enough for me. I proceeded at once to apply the new instrument to the solution of interesting and important geometrical and physical problems, with gratifying results. Confidence in the validity of the processes was quickly and firmly established. My satisfaction with this method was strengthened by the discovery that Comte in his later years veered to the view that there is a transcendental element in the calculus which renders all attempted demonstrations alike irrational and futile. The laws of the calculus, like Newton's laws of motion, are to be accepted because in all their applications they are always found to agree with the facts of experience. Even quite recently the late Sir Oliver Heaviside, a most original mathematician, committed himself to the opinion that "within the last twenty-five years we have erred in attempting to lead the student to a working knowledge of the calculus by first convincing him that the reasoning is sound It is quite possible that the fundamental principle of the calculus does not admit of deductive demonstration" I gained an added appreciation of the sage suggestion of the Autocrat at the Breakfast Table that a mathematical demonstration is often a *pons asinorum* over chasms which shrewd folk can bestride without the aid of such a structure I also found this an advantageous starting point for an examination of the devices for bridging the chasm separating the quotient of increments from the quotient of differentials proposed by D'Alembert, La Grange and Weierstrass and his school

---

[1] "The Physical Geography of Southern New England," *Nat. Geog. Monograph*, 1: 276, 1895.

These early experiences were brought back into the memory with vividness and force when, the other day, I stumbled upon an interesting passage in an article in the *Contemporary Review* for June, 1918. The author of the article is the Rev Dr D S Cairns, an eminent Scottish divine and professor of dogmatics in the United Free College, Aberdeen Principal Lindsay, to whom reference is made, was for many years at the head of the United Free College, Glasgow The quotation follows

> The great and dramatic moments in the progress of science are when its pioneers, after long brooding over the data which set their problems for them, leap far ahead of all verified knowledge and divine the solution, when Newton goes ''voyaging through strange seas of thought, alone,'' when Darwin sees his unifying truth in a south country lane, and Wallace, ill with fever in the southern island, is ''stung by the splendour of a sudden thought'' The story of the last century is full of such records, and it is not too much to say that the whole fabric of modern science and industry rests upon the truths discovered in such inspired moments Let me add another not generally known to these histories My friend and colleague, the late Principal Lindsay, once told me that Lord Kelvin told him that he never thought his way quite up to any one of his great discoveries He said that he brooded over the facts, which set him his problem, until there came a moment when his mind made a mortal spring out beyond any thing that he, or any man, could demonstrate, and that he knew then in the very marrow of his mind that the solution lay in a certain fact or set of facts He said further, and this, I think, is of peculiar interest, that he was never able himself to supply the intervening steps, and that before he announced his discoveries he always got Tait or Clerk Maxwell to work out these intervening steps for him. I repeated this story once to two or three distinguished biologists, one Scottish and the other Continental (both of them, by the way, Gifford Lecturers), and they said at once that that was how the great discoveries of science were always made, that the end was seen before the means.

EVAN THOMAS

UNIVERSITY OF VERMONT

ON "THE NEW CYTOLOGY"

IN the March 20th number of SCIENCE Dr. Alexis Carrel has summarized in a general statement of its problems the principles and methods of the new cytology In particular he emphasizes the point that "structure and function are two aspects of the same thing" that "must be considered simultaneously" As methods to such an end he describes in some detail his use of tissue culture and also states: "There are two ways of preventing the death of tissues and organs removed from the organism. One was originated by Ludwig and the other by Harrison Ludwig supplied the blood vessels of an excised organ with artificial circulation of a proper fluid" And after describing the difficulties of this technique, adds, "the old method of the physiologists of the nineteenth century is being rejuvenated, and may become one of the most useful tools of the new cytology"

The purpose of the present communication is to call attention to just such an application we have made of Ludwig's method to cytological problems. Our specific problem was that of experimental nephritis, and in its investigation the method of perfusion was applied to the frog's kidney In the first article of two which will appear shortly in the *Journal of Experimental Medicine*, we describe the functional disturbances of the kidney lesions following the administration of renal poisons not, as is usually the case, to the living animal, but directly to the isolated organs by way of the modified Locke's solution with which they were perfused. In the second paper the structural changes in the perfused tissues are considered and, to quote from our conclusions, "the two aspects of damage (functional abnormalities and structural change) can be correlated to a reasonable degree"

The structural changes in these perfused kidneys were found to be identical with the anatomical lesions which follow the injection of the same poison into the living frog; in fact, an experimental nephritis was produced in the isolated organs. The finer cytological changes involving the nucleus, such as pyknosis, karyorhexis and karyolysis were observed as well as the protoplasmic changes which accompany cell death Pathological alterations in the granular and mitochondrial elements of cells were particularly well reproduced in the isolated organ, as for example, "cloudy swelling," mitochondrial clumping and other elements of the classical picture of cell damage. Such changes can not be considered mere artifacts, due to the artificial character of the perfused tissue's environment, for the kidneys functioned in a perfectly normal manner under the conditions of the experiment before their production and, as will be shown later, the functional response to damage was that which is observed when the kidney is damaged *in vivo*.

In the discussion of our results we have called attention to the significance of the method for problems of normal cytology, as in the histological study of functioning mitochondria or in vital staining. To quote from our conclusions, "The tissues or organs thus studied are isolated from the complications of circulatory and nervous mechanisms, their environment is artificially and rigorously controlled and conditions are therefore analogous in a certain degree to those which obtain in the study of tissue culture." It is obvious, however, that such an application of Ludwig's method may eventually go a step beyond tissue culture, for not only can the reactions of cells and tissues be investigated thereby, but as our experiments with the kidney show, the pathological as well as the normal responses in both structure and function of entire organs can be examined.

The outcome of our experiments suggests that such an extension of Ludwig's method to anatomical investigation as we have employed may complement the method of tissue culture and perhaps aid, as Dr. Carrel hopes, in "a rejuvenation of Virchow's doctrine of cellular pathology."

JEAN OLIVER

LONG ISLAND COLLEGE OF MEDICINE,
BROOKLYN, N. Y.

CHROMOSOMES OF PETUNIA

PRACTICALLY all papers dealing with *Petunia* which have been published during the last four years cite references to show that the typical number of chromosomes for this genus was first recorded in 1927. In the interest of bibliographical accuracy, may I call attention to an abstract[1] published in December, 1924, in which the following statement occurs—"The number of chromosomes is clearly seven and fourteen."

ALICE M. OTTLEY

WELLESLEY COLLEGE

NEWTON'S SAYING

IN the June 12 issue of SCIENCE, Dr. S. A. Mitchell quotes Newton as saying "I have been but as a child playing on the seashore, now finding some pebble rather more polished and now some shell more agreeably variegated than another, while the immense ocean of truth extended itself unexplained before me."

This saying is so important and so often quoted that I think it worth while giving the correct form, which is, "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble, or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

CHARLES HERRMAN

SOCIETIES AND ACADEMIES

THE SECOND INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE AND TECHNOLOGY

LONDON, JUNE 29 TO JULY 4, 1931

THIS congress was the outcome of a movement started by the Comité International d'Histoire des Sciences, which was organised at Oslo in 1928 and which meets annually in Paris. This Comité secured the cooperation of its parent body, the Comité International des Sciences Historiques, the History of Science Society, and the Newcomen Society for the Study of the History of Engineering and Technology, and was generously assisted by the British Government, the Science Museum, the British Museum, the Royal Society and the Universities of Cambridge and Oxford. Official representatives were present from the universities of twenty-five countries, and numerous members from these universities and several others. The congress was held under the presidency of Dr. Charles Singer (London), the vice-presidents being Professor Gino Loria (Genoa) and Dr. George Sarton (Harvard). The following is the program of sessions and a summary of the papers.

INAUGURAL SESSION, MONDAY, JUNE 29

The congress was opened by an address by the Right Honorable H. B. Lees-Smith, M.P., president of the board of education, who expressed his belief that the greatest events in the history of the world had taken place in the realm of ideas, and particularly in the ideas developed in the minds of men of science and technology. The achievements of science and technology, he said, were now progressing with such rapidity that the mind has become dazed and has almost lost the capacity for surprise. He asserted that science and technology were immeasurably beneficent and at the same time completely merciless, furnishing the world with fearful instruments of destruction in war and with the means for saving the lives of the wounded. He raised the question whether the moral progress of mankind was keeping pace with the material development If not, another great war like the last would see the end of western civilization

---

[1] Margaret C. Ferguson, "Preliminary Announcement of a Cytological and a Genetical Study of Petunia," *Anat. Abst.*, 28–29, No. 116, p. 137, 1924–1925.

In his presidential address Dr Singer urged that the teaching of the history of science should replace the present history of conquest, asserting that the rise of science was the most important event in human history since the fall of the Roman Empire, and that text-books which did not say as much did not teach the truth The critical years which saw the foundation of the Royal Society, the publication of Hooke's "Micrographia," Newton's work on prisms and his "Principia" were, he asserted, generally referred to in school histories only in connection with battles

At the close of the Monday session the members were received for tea at the Science Museum by the president of the Board of Education and Mrs Lees-Smith, and by Sir Henry Lyons (director of the Science Museum) and Lady Lyons In the evening Dr and Mrs Singer gave a reception at the Royal Society of Medicine This was followed by an interesting and informative address by Professor E N da C Andrade, who impersonated in manner and dress Francis Hauksbee, F R S, who died in 1713 and was one of the pioneers in the study of electricity The address was based upon one originally delivered by Hauksbee under the title, "A Discourse with Experiments on Various Subjects, Giving an Account of Several Surprising Phenomena, Touching Light and Electricity, with many other Remarkable Appearances Not Before Observed," and was illustrated by experiments made by him, in which use was made of the original air-pump which he constructed In the course of the address Hauksbee's prognostication of the incandescent electric light appeared Later in the evening there was an exhibit of material from Dr R C Clay's collection of historical optical instruments and from Mr G H Gabb's collection of Priestley relics

On Tuesday two sessions were held at the Science Museum The first was devoted to the topic, "The Sciences as an Integral Part of General Historical Study," with Professor Gino Loria (Genoa) as chairman, the opening address being delivered by Professor G N Clark (Oxford) The former gave a general summary of the situation, after which the latter, speaking as one concerned mainly with international relations, showed the necessity for studying the history of technology if the problems of war, industry and transportation were to be understood, and asserted that the fundamental principles of politics, philosophy and social organization could not be studied in isolation from those of science Addresses in the form of discussion of the major topic were then delivered Sir William C D Dampier-Whetham (Cambridge) divided history into four periods, (1) the picturesque (kings, battles), (2) legal and constitutional, (3) economic (the industrial revolution), and (4) that in which science stands supreme Professor A V Hill (London) compared for importance certain military achievements with contemporary scientific discoveries, such as the year of the middle of the Thirty Years War (1628) with the publication of the small Latin treatise of seventy-two pages, by Harvey, on the circulation of the blood, and he asserted that the achievements of Darwin, Newton, Faraday, Maxwell and Rutherford had a more worthy claim in text-books for children than the events now chronicled Professor A M Mosharrafa (Cairo) spoke of the four characteristic aspects of contemporary thought with respect to physical science—(1) the revolutionary aspect, (2) the tentative aspect, (3) the philosophic aspect, (4) the mystical aspect—and asserted that the method of science, in contrast with its outlook, has remained substantially unaltered Dr E J Holmyard (Clifton College, Bristol) called attention to the fact that the twelve large volumes of the "Cambridge Modern History" contain only fifty pages on the history of science

The second session was devoted to the topic, "The Teaching of the History of Science," Dr W H Welch (Johns Hopkins) acting as chairman The opening address (in French) was delivered by Professor Aldo Mieli, permanent secretary of the Comité International d'Histoire des Sciences (Paris), who called attention to the fact that the educative value of the history of science in general culture has been recognized only recently, that the science of to-day is only an instantaneous photograph of a present in perpetual development, and that the history of the subject is bound to have a place in the regular courses in our schools The discussion was opened by Professor A E Heath (University College, Swansea), who took for his thesis the statement that historical considerations gain in importance as science makes life more complex, and hence that the more the physical sciences gain in importance, the greater the need to see them in wider perspective Professor A Wolf (London) sketched the story of the introduction of the history of science into the curriculum in London and stated some of the problems involved Professor David Eugene Smith (Columbia) spoke of the value of the history of mathematics in eliminating the obsolete and in selecting appropriate substitutes He described the three-year course given by him prior to his retirement from active service Professor Q. Vetter (Prague) described (in French) the teaching of science in Czecho-Slovakia, speaking of the steps taken in the reform of the schools under the new régime. Dr F H Hayward (inspector, London) proposed the introduction of "Celebrations of Science" in the schools, the purpose being to keep specialists in science in contact with the vast and growing knowledge of other branches, and the general public in contact with the growth of science Professor M Stephanides (Athens) spoke (in French) on the history of the sciences in Greece, calling attention to the danger of its becoming merely archeologic in its nature He described the general plan of his course Mr F S. Marvin (Cairo) described three channels by which the history of science may profitably be taught—(1) by incorporating it in courses in general history, (2) by class and laboratory work in historic experiment and discovery, and (3) by special courses in the history of the sciences already studied—and spoke of the advantages and disadvantages of each Mr Thomas Greenwood (London, Birkbeck College) presented the claims of mathematics as a necessary constituent element of both philosophy and technology, stressing the demands of philosophy M Emile Meyerson spoke (in French) upon the efforts made in the past to consider the relation of science to history and urged the necessity of training teachers to meet the present needs.

Some interest was aroused in the Tuesday meeting by the request of the Soviet delegation that five of its members might be heard Each delivered a prepared address and this, with various others of members of the delegation, was circulated in printed form to all present at the congress The general nature of these addresses (eleven in number) may be inferred from the following quotations from one of those most forcefully presented, that of Professor M Rubinstein (Moscow Institute of Economics)

> The relations between science, technology and economics under the conditions of capitalistic society and under the socialistic system that is being built up in the Soviet Union, are distinctly different and in many respects, diametrically opposite The capitalistic system of production and social relations is antagonistic by its very nature Along with its growth and development there goes on the development and growth of the profoundest intrinsic contradictions that are manifest in all branches of human existence without exception.
>
> The social system for one sixth of the world has now become Socialism. And one can not understand anything about the future perspectives of science and technology as well as about the perspectives of their interdependence, without the study *of the laws of development*, of the struggle and growth of the new socialistic system of social relations

That each of these papers was manifestly a contribution to Soviet propaganda of socialism, rather than to the history of science and technology, does not detract from their interest.

On Wednesday and Saturday there were no sessions of the congress, a large number of the members visiting Cambridge and Oxford, respectively, being entertained at luncheon and tea at various colleges There was also an Independence Day Luncheon at University College, London, on July 4

On Thursday the session was devoted to the "History and Contemporary Interrelationship of the Physical and Biological Sciences," under the chairmanship of Professor William Ritter (California) The opening addresses were delivered by Professor J S Haldane (Oxford), Dr E S Russell (Board of Agriculture) and Dr Joseph Needham (Cambridge). Professor Haldane expressed the view that in the study of each example of life we are confronted by experiences which can only be interpreted as the manifestation of a persistent and indivisible unity, recognized quite naturally and in common language as the life of the organism and the stock to which it belongs, and showing itself in endless coordinated details of form, environment and activity which express it In physical science we are dealing with what we interpret as separable material parts and events, but in biological science we are dealing with what we can never interpret in this way, since the parts and events are manifestations of the coordinated whole which we call the life of the organism When Galileo took the first definite steps towards a physical interpretation of our experience he entered upon what proved an extraordinarily fruitful path, but he made a mistake by assuming that his interpretation was "objective" or represented fundamental reality It has been accepted generally by the scientific world up to the present time, but has made any satisfactory scientific treatment of biology impossible Dr Russell was also of the opinion that the influence of the physical sciences on biology has been, on the whole, unsatisfactory The doctrine of Descartes, that animals may, and for the purpose of science should, be treated as automata, has prevented the development of a real science of animal behavior and hence of animal ecology Dr Needham joined in objecting to an interpretation of biology from the purely physical standpoint. Any such demand implies the physics of the future and not only the physics of to-day The speaker adduced various illustrations to establish his thesis All through the history of biology we see the pendulum swinging backwards and forwards between more or less crude mechanism and belief in physics, on the one hand, and more or less crude vitalism and the skepticism of physics, on the *other* Dr J H. Woodger (London) stated that the attempts to understand relationships between physical and biological sciences have been vitiated by the long-drawn-out scandal of the metaphysical quarrels between mechanists and vitalists. He called attention to the method of procedure necessary to lead to safe conclusions, paying a tribute to the work of such scholars as Whitehead and Russell Professor Lancelot Hogben (London) called attention to the fact that there was never a time when biologists were more confident of the usefulness of physico-chemical methods in arriving at conclusions as to the behavior of organisms, or when there was such wide-spread alarm at the philosophical consequences of admitting that this is the case. This contradiction is due in part to the ecclesiastical origins of Western culture and partly to contemporary social unrest In our generation materialism has become the official creed of 150,000,000 people, but among men of science the mechanistic tradition is not at present fashionable in spite of its growing strength in laboratory practice Mr L L. Whyte called attention to the new type of fundamental law established by recent atomic theory, particularly with respect to the quantum theory, which became estabilized in 1927 and has not seriously been modified in the last four years

Professor L G M Baas-Becking (Leiden) asserted that infinity and limitation in space and time, continuity and discontinuity, free will and predestination and the existence of God were kindred and basic antimonies which could perhaps be derived from one another, and that a synthetic solution for one might solve the whole.

The session on Friday was devoted to the topic "The Interdependence of Pure and Applied Science" the chairman being Sir Henry Lyons, director of the Science Museum There were two opening addresses, the first by Sir W Napier Shaw and the second by Professor William McDougall The former considered the expansion of the Socratic distinction between pure and applied science to express the development of science in terms of (1) an observatory for the acquisition of experience, (2) a laboratory for the formation of ideals, (3) a library for the development of cooperation, and (4) an arena for exposition and discussion.

In the discussion, Professor Dannemann (Bonn) stated that a great part of the deliberations were concerned with the question of how natural or technical subjects may be connected with their history He was convinced that the general synthesis or comprehension of the sciences and their connection with the history of civilization must be the work of one man, and such a work he has already planned Professor C H Desch (Sheffield) deplored the fact that popular interest lay rather in the applications of science than in science itself. The continuity of scientific discovery is the important thing, for inventions are the result of long preparation in pure science. Professor F. G. Donnan (University of London) was of the same opinion and urged the encouragement of theoretical study in the field of industry Mr R. V. Vernon (Colonial Office) joined the preceding speakers in the hope that pure science might be encouraged without direct interest in its applications. In particular he expressed appreciation for the attitude shown in government service. Dr G Windred called attention to the many examples of the manner in which pure science has produced discoveries of great practical value in the field of electrical theory. Among others was the case of Oersted's observance (1820) of the magnetic effect of an electric current, followed by the work of Biot, Savart, Ampère and Maxwell Mention was also made of the theoretical work of Kelvin, Maxwell, Chasles, Faraday, Stokes, Wilhelm Weber, Sir J J Thomson, Kennelly, Heaviside, H von Helmholtz, and others Dr Marie C. Stopes (London) spoke upon the relation of pure science to the study of the coal situation. Dr. A. Joffe (Leningrad), one of the Soviet delegates whose papers were issued in pamphlet form, confined himself more closely to the scientific question than some of his colleagues had done and specified clearly eight problems "forgotten by physicists yet of importance to technique" Of these the first was "A reversible oxidization of coal" which, he stated, "could three or four times increase the energy available for technical purposes."

Abstracts of papers were also circulated, including one by Messrs. H E. Stapleton and Hidayat Husain, "Report on the Mā al-Waraqi," an unpublished work of the tenth century on alchemy and its relation to later European treatises. Dr. S. V. Larkey (California) reported on his studies in the field of early English medicine and biology A statement as to the project for the publication of Newton's correspondence was also circulated, suggesting that 1942, the tercentenary of the birth of Newton, would be an appropriate time for the work to appear. Circulars relating to the proposed scientific section of the Chicago Centennial Exhibition of 1933 were also distributed.

Mention should also be made of the exhibit in the British Museum relating to the First Century of Science in England (Bruno to Newton, 1584–1687). Printed works of twenty-eight scientists were shown. A special catalogue of the portraits of scientists in the National Portrait Gallery was also issued.

Numerous visits to places of interest in London were planned and several receptions were given, notably those at the Royal Society by the president, Sir Frederick Hopkins, and Lady Hopkins; at the Royal Institution by the president and managers; at the Institute of Historical Research, by the director and committee; at the Royal College of Physicians, by Lord Dawson, of Penn, and Lady Dawson, and the one by Dr. and Mrs. Singer, as already mentioned On Friday evening a banquet was held at which various delegates spoke.

DAVID EUGENE SMITH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TRIPLE-SPECTRUM DISCHARGE TUBE

THE mercury-vapor lamp is probably the most generally useful light source for spectroscopic, optic and general instruction laboratories Many times, however, the supply of lamps is not equal to the demand, and the availability of inexpensive substitutes is very desirable For this reason the possibilities of the electrodeless discharge were investigated, and it was thought that the results obtained might be of general interest

A pyrex glass tube A about 20 cm long and 4 cm in diameter was provided with a side tube B and a "sucked-in" thin glass end C[1] Ten grams each of zinc, cadmium and mercury were placed in the tube The tube was placed in an oven and baked at 450° C for several hours, while the gases in the tube were removed by a mercury diffusion pump During the baking-out process the mercury was kept in B, which was arranged to be out of the oven Just before the tube was sealed off at D, the mercury was distilled from B to A

The completed tube was mounted in an asbestos box equipped with two "Glo-coils" as shown in the figure

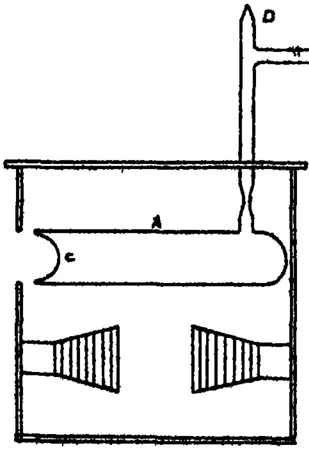


FIG 1

A helix of 8 turns of No 8 copper wire was placed around A. The helix was connected in series with a variable spark gap and the secondary of a 1 K V A Thordarson transformer Three Leyden jars were connected in parallel with the helix. The variable spark gap, which was enclosed in a sound-proof box, is essential to obtain a discharge which fills the entire tube. In order to prevent the mercury from depositing on C while the tube is in operation, the helix should extend well to the end of the tube. Best results are obtained if large-sized wire is used for all electrical connections

Three quite distinct types of discharge may be obtained with this tube.

(1) If all the mercury is left in A and the tube slightly warmed, a discharge quite comparable in intensity to ordinary mercury arcs results Mercury and zinc lines are prominent In the present case the thin glass window transmitted with great intensity ultra-violet radiation to 2,536 Ang.

(2) By heating the tube strongly a large part of the mercury may be distilled to B and the discharge becomes bright green In this case the visible spectrum consists largely of the strong mercury lines and the cadmium triplets

(3) If practically all the mercury is distilled to B, the tube may be operated to give a very steady discharge even when cold. In this case mercury, zinc and cadmium lines are present The cadmium red line—the international standard—appears quite strongly under these conditions.

The result is an inexpensive but brilliant light source which transmits the ultra-violet well and which produces lines extending well into the red—facts which make the tube desirable for spectroscopic calibration The lines are very sharp, since the tube may be operated at low temperatures and the Doppler effect is small

R WILLIAM SHAW
GEORGE B. SABINE

CORNELL UNIVERSITY

THE ADJUSTABLE DOUBLE SLIT

MR. R WILLIAM SHAW recently (SCIENCE, Vol 73, April 24, 1931) described an ingenious mechanism permitting the continuous variation of the distance between two optical slits A more complicated apparatus with means for adjusting also the widths of the two slits was devised by L. E Dodd and G H. Jung. (J. O S. A. and R S I, Vol 15, p 181, 1927) Adjustable double slits have been used chiefly for laboratory repetition of Michelson's stellar interferometer experiment.

The special problem of the adjustable double slit is, as Shaw points out, that of keeping the varying space between the slits closed Shaw accomplishes this by sliding between the slits a tapering brass plate; Dodd and Jung employ a rolling curtain, similar to a window shade.

A method used here with success may be worthy of record on account of its simplicity. Two thin, rectangular plates, which may be of either cardboard or brass, are hinged together along one edge and the hinge made light-tight by a backing of black paper. The free edges opposite the hinge are attached respectively to the inside jaws of the two slits As the slits are caused to recede from or to approach each other these plates open and close like a book When used as in the stellar interferometer the back of the book is directed away from the telescope objective and is out of the way of all other parts

---

[1] C. M. Slack, *J O. S. A.*, 18, 123, 1929.

PAUL KIRKPATRICK
DEPARTMENT OF PHYSICS,
UNIVERSITY OF HAWAII

SPECIAL ARTICLES

FURTHER OBSERVATIONS ON AN INHIBITOR PRINCIPLE ASSOCIATED WITH THE CAUSATIVE AGENT OF A CHICKEN TUMOR[1]

IN recent communications[2] attention has been called to certain evidence indicating the presence of an extractable principle in a chicken tumor, which tends to inhibit the activity of the causative agent in the transmission of this tumor The present report deals with some additional properties of this inhibiting agent.

The most satisfactory source of this material has been found to be the desiccate of a relatively slow-growing Chicken Tumor I A solution is prepared by extracting the desiccate with water, filtering through paper and then heating at 55° for 30 minutes to destroy the tumor-producing factor in the extract This material, mixed with equal volumes of various concentrated, highly active fresh tumor extracts, shows a marked inhibiting action The results of 69 test inoculations showed complete neutralization of the activity, with no tumor formation, in 59 cases (86 per cent) The remaining 10 cases gave evidence of considerable inhibiting activity, in that the resultant tumors were, without exception, much smaller than the controls The 30 control inoculations of the fresh extract in every instance resulted in actively growing tumors It was further observed that heating of the extract to 65° or over damaged or destroyed the inhibiting action.

An extract of Chicken Tumor 10, a slow-growing fibrosarcoma, heated to 52° C, has been found to inhibit the development of Chicken Tumor I, a rapidly growing tumor The results of 31 tests gave complete neutralization in 8 cases (26 per cent), and the average size of the tumors in the remaining animals was definitely smaller than in the controls The latter group showed 100 per cent of actively growing tumors

The outcome of the above experiments suggested that the inhibitors might not be so specific in their activity as the etiological agents On the basis of this possibility, tests have been made on the action of the inhibitor on transplantable mouse sarcomas One of the standard tumors, designated as 180, a sarcoma which gives a high percentage of takes and rarely if ever retrogresses when once established, was selected for the first test Of 94 inoculations of tumor cell suspension, mixed with equal volumes of chicken tumor extract previously heated to 55° C, no tumors developed in 83 cases (88 per cent) In the control group of 70 inoculations of the same tumor cell suspensions diluted with Ringer's solution, there were 15 cases (21 per cent) which developed no tumors Further controls with extracts of chicken liver and brain, with normal rabbit and chicken serum, and with the chicken tumor extract heated to over 65° C gave no significant variation in the number of takes or in the growth rate of the tumor from those shown by the other controls. The few tumors which occurred in the first group, resulting from the inoculation of tumor cells and inhibitor, were smaller than in the controls and tended to become stationary after the first week, or to grow very slowly.

Similar tests have been made on another mouse sarcoma, S/37, which is more rapidly growing than 180, generally killing the animal in from two to three weeks An insufficient number of animals has been used to justify a final conclusion, but the general indications are that the chicken tumor extract reduces the number of takes and slows the development of the tumor in a significant percentage of inoculated animals Additional tests are in progress with this tumor and on a mouse carcinoma and on a rabbit epithelioma. With the latter two neoplasms the preliminary experiments show little indication of any retarding action by the "inhibitor"

It is considered that the action of the inhibitor on the chicken tumor agent is probably a neutralizing phenomenon With the mouse tumor the possibility exists that the result may be due to an incidental enzyme in the chicken tumor extract, which damages the tumor cells The fact that the treated mouse tumor cells appear to multiply for a few days after inoculation and the absence of any signs of damage to the host tissues at the site of inoculation are, however, some indications that this is not the correct explanation.

---

[1] From the Laboratories of the Rockefeller Institute for Medical Research

[2] Jas B Murphy, O. Helmer, A Claude and E Sturm, SCIENCE, 73, 266, 1931, Jas B Murphy, *Trans Assoc Amer Physicians*, May, 1931 (in press), M J Sittenfield, A S Johnson and J. W. Jobling, *Proc Soc Exp Biol and Med*, 28, 517, 1931.

JAMES B MURPHY
ERNEST STURM

HUMAN SERUM, AGE AND MULTIPLICATION OF HOMOLOGOUS FIBROBLASTS[1]

THE experiments of du Nouy[2] have shown that the rate of cicatrization of a sterile wound is a function not only of the area of the wound but also of the age of the patient Simply stated, the area of the wounds being the same, the rate of repair is faster in young individuals than in old Later work by Carrel and Ebeling,[3] and by Baker and Carrel,[4] has demonstrated that these findings may be explained on the basis of progressive physico-chemical changes which take place in the blood plasma during the lifetime of the individual These authors have shown that the inhibiting action of homogenic and heterogenic serum on the growth of pure cultures of chicken fibroblasts is directly proportional to the age of the animal from which the serum is taken This process of aging, which advances more rapidly during early life, is due, in part at any rate, not only to the loss of growth-activating substances, but also to an increase in concentration of inhibiting proteins and lipoids, particularly the latter The curve representing the increase of these substances resembles the curve of the index of cicatrization, of du Nouy's formula, as a function of the age of the individual After extraction of the lipoids, the remaining proteins are found to be far less inhibiting than the whole serum Also, when the serum of an old fowl is diluted so that its protein concentration corresponds practically to that of a young fowl, its growth-inhibiting power, although markedly decreased, is still higher than that of the serum from the younger animal Carrel[5] has also shown that the toxic substances which characterize old age are being continuously secreted by the tissues Their progressive accumulation in the blood is not the result of lack of elimination from the circulation, it is rather an expression of the condition of the tissues. When the blood plasma was removed from old dogs by plasmaphaeresis, and was replaced by Tyrode solution, their serum was less inhibiting for a short time thereafter, but rapidly regained its former characteristics as the plasma was regenerated by the tissues This recovery took place too rapidly to allow of a definite modification of the tissue cells

The experiments here to be reported bring additional evidence of a confirmatory nature by demonstrating a striking contrast between the action of infant and adult sera on colonies of human fibroblasts cultivated *in vitro* The fibroblasts were derived from a subcutaneous rheumatic nodule removed at biopsy from a seven year old male, and have been cultivated for three months in flasks on a medium consisting of a mixture of 20 per cent adult human serum and 80 per cent chick embryo tissue juice When the experiments were made, this strain had been cultivated for almost two months and had been subdivided and transferred seven times The cultures selected for the experiments were divided and the two halves of each were placed in separate flasks One half of each was treated regularly with serum obtained from a 14 months old infant and the other half with serum from a 27 year old adult In order to intensify the effect of the sera to be compared, the usual proportions were reversed so that the mixture consisted of 80 per cent serum and 20 per cent chick embryo juice The results obtained from three such experiments which were made simultaneously, and with the same materials, have been averaged and presented in Fig 1 It may readily be seen that the cultures treated with the infant's serum attained an area in ten days which was over 150 per cent greater than that reached by those treated with adult serum.

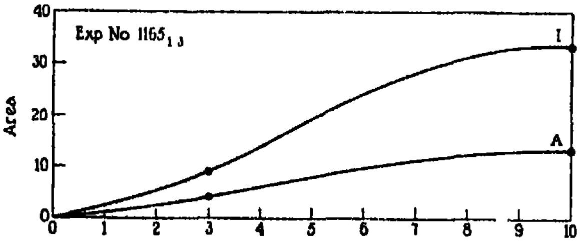


FIG 1 Comparison of the rate of growth of human fibroblasts in the sera of a 14 months old infant and a 27 year old adult I = infant's serum, A = adult serum

The author wishes to express his gratitude to Dr. Currier McEwen and Dr Bernard Benjamin, of the Hospital of The Rockefeller Institute for Medical

---

[1] From the Laboratories of The Rockefeller Institute for Medical Research

[2] P L du Noüy, "Cicatrization of Wounds III The Relation between the Age of the Patient, the Area of the Wound, and the Index of Cicatrization," *J Exper Med* 24 461 (Nov) 1916

[3] A. Carrel and A H Ebeling, "Antagonistic Growth Principles of Serum and Their Relation to Old Age," *J. Exper Med* 38 419 (Oct) 1923

[4] L. E Baker and A Carrel, "Effect of Age on Serum Lipoids and Proteins," *J. Exper Med* 45 305 (Feb.) 1927.

[5] A Carrel, "Diminution artificielle de la concentration des protéines du plasma pendant la vieillesse," *C. R. de la Soc. de biol* 90· 1005 (April 18) 1924.

Research, for material used in connection with the experimental work.

RAYMOND C PARKER

THE ROCKEFELLER INSTITUTE,
NEW YORK, N Y

A PRACTICAL TEST FOR POTENCY OF EXTRACT OF CORPORA LUTEA

THE large amount of work which has been done, in the last few years, upon extracts of corpora lutea, and the results of that work, have urgently called for a suitable test for potency Corner's and Allen's[1] studies on progestational proliferation in the rabbit, resulting from the physiological action of their extract of the corpus luteum, and Hisaw's and Leonard's[2] similar results, provided a useful test, but one which had several practical objections, arising primarily from the relatively large size of the test animal, and the consequent expense of obtaining and maintaining the animals and of making the tests

To overcome these objections, W M Allen[3] attempted to transfer the application of this technique, using rats as test animals As a result of thorough studies, he concluded that "The histological alterations of the rat's endometrium during pseudopregnancy are insufficient to warrant the use of these changes as a test for corpus-luteum extracts" At the same time we obtained wholly confirmatory, though as yet unpublished, results in this laboratory We also had similar results in studies conducted on the uterus of mice

The results of our studies upon histological changes in the vaginal mucosa of mice have, however, been very satisfactory, and we now present some of them as the basis of a practical test for potency of extracts of corpora lutea.

From histological studies made upon the vaginae of 19 normal mice in different stages of the oestrous cycle, and of pregnancy, it was apparent that the normal changes in the histological picture of the vagina of mice is similar to that described by Long and Evans[4] for the rat

Histological changes of the vaginal mucosa, comparable to those occurring during pregnancy, were found when normal, adult, unmated, female mice were treated, just after oestrus, with an extract of corpora lutea, in all of 13 test animals, treated with daily injections of extracts for periods ranging from 3 to 14 days For test purposes, however, it is recommended that periods of more than 7 days be used.

At present we recommend the following test· Beginning the day after oestrus, make daily injections of 0 25 cc of corpus-luteum extract per test animal for a period of 9 to 14 days. The vagina, upon being preserved, sectioned and stained, according to the usual histological technique employed in such cases, will show, with an extract potent for maintaining pregnancy in ovariectomized, pregnant animals, a histological picture characteristic of pregnancy, *i.e*, absence of cornified epithelium and of infiltration of leucocytes, presence of vacuolization of the superficial and middle cell layers, mucous transformation, *et cetera*

This test has several obvious advantages The test animals are small, easy and inexpensive to obtain and maintain, and the test occupies a relatively short period Furthermore, 2 to 3 ccs of extract is sufficient to make a test upon one animal It may even be that a smaller dosage than that of 0 25 cc. per day will be found to be effective, as the minimal effective dose has not yet been ascertained Experienced workers will also probably find that the period of time recommended for the test may be reduced with safety

The extract used in these tests was one prepared by Dr J J Pfiffner, and has been the basis of much of our work upon the physiology of corpus-luteum extract It is similar to Corner and Allen's extract, save that methyl alcohol is used in place of ethyl alcohol as the first extracting agent

Similar tests made as controls upon five animals with Swingle and Pfiffner's[5] extract of the adrenal cortex did not bring about a pregnant appearance of the vaginal mucosa in non-pregnant mice.

REGINALD G. HARRIS
DOROTHY M. NEWMAN

THE BIOLOGICAL LABORATORY,
COLD SPRING HARBOR, L. I, N. Y

BOOKS RECEIVED

AVELING, FRANCIS. *Personality and Will.* Pp. viii + 246 Appleton. $2.00.

CLEPPER, HENRY E. *The Deer Problem in the Forests of Pennsylvania.* Pp 45. Illustrated. Department of Forests and Waters. Commonwealth of Pennsylvania, Harrisburg

REID, EDITH G *The Great Physician:* A Short Life of Sir William Osler. Pp ix + 299. Illustrated. Oxford University Press. $3.50

---

[1] G W Corner and W M Allen, "Physiology of the Corpus Luteum II Production of a Special Uterine Reaction (Progestational Proliferation) by Extracts of the Corpus Luteum," *Am Jour Physiol*, 88, 326, 1929.

[2] F L Hisaw and S L Leonard, "Relation of the Follicular and Corpus Luteum Hormones in the Production of Progestational Proliferation of the Rabbit's Uterus," *Am Jour Physiol*, 92, 574, 1930.

[3] W M Allen, "I Cyclical Alterations of the Endometrium of the Rat during the Normal Cycle, Pseudopregnancy and Pregnancy II Production of Deciduomata during Pregnancy," *Anat Rec*, 48, 65, 1931

[4] J. A. Long and H. McL Evans, "The Oestrus Cycle in the Rat and its Associated Phenomena," Memoirs of the University of Cal., Vol. 6, 1922

[5] W. W Swingle and J J. Pfiffner, "An Aqueous Extract which Maintains the Life of Bilaterally Adrenalectomized Cats," *Am. Jour. Physiol.*, 96, 164–179, 1931.

SCIENCE

VOL 74 FRIDAY, AUGUST 21, 1931 No 1912

The Function of Research in Engineering Education PROFESSOR DUGALD C JACKSON 183

The Unsolved Riddle of the Solar System CARR V VAN ANDA 187

Obituary
Russell A Oakley H N VINALL *Memorials, Recent Deaths* 195

Scientific Events
Mediums for the Isolation and Cultivation of Bacteria in the Filterable State, The London School of Hygiene and Tropical Medicine, The Return of "The Discovery", Additions to the Herbarium of the U S National Museum 196

Scientific Notes and News 198

Discussion
The Summer Meeting of the American Association for the Advancement of Science in 1933 COLONEL JOHN STEPHEN SEWELL *The Marine Laboratory of the University of Sydney, Australia* DR T WAYLAND VAUGHAN *Developing New Varieties of Hops* E N BRESSMAN *Polyembryony in Red Spruce* DR HENRY I BALDWIN, WARREN E PERCIVAL *Abbreviations for Scientific and Engineering Terms* E H MCCLELLAND 201

Scientific Apparatus and Laboratory Methods
The Microphone Amplifier PROFESSOR R C COLWELL, L FULLMER *The Use of a Hot Cathode Helium Lamp as a Source of Monochromatic Light for the Polariscope* DR ALEXANDRE ROTHEN 204

Special Articles
Action Currents in the Auditory Tracts of the Midbrain of the Cat DR H DAVIS, DR. LEON J SAUL *The Effect of Hypophysectomy on Gestation in the Rat* R I PENCHARZ, PROFESSOR J A LONG 205

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE FUNCTION OF RESEARCH IN ENGINEERING EDUCATION[1]

By Professor **DUGALD C JACKSON**

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

to sift the grain from chaff,
Get truth and falsehood known and named as such

MORE than thirty-five years ago Dr Robert H Thurston, then director of Sibley College, was a guest at the University of Wisconsin where I was a youthful and rather new member of the faculty trying to build up suitable laboratories of electrical engineering with inadequate funds. We had much extemporization by teachers and students in the use of equipment This brought to the surface the peculiarities of each piece of apparatus used in unusual relations, and we were having a grand time experimentally determining the reasons for various observed phenomena which hitherto had not been fully explained Dr Thurston walked about our few and meager machines while I told him what we were doing with them and how they served as elements of student work Then he simply remarked that he was pleased to find us "carrying on so much research"

I confess that this remark of his struck me with rather profound surprise and the impression that it gave me is still rather vivid We (the teachers and students in electrical engineering) were testing and investigating various strange or unfamiliar effects, but this was all in course of satisfying our curiosity regarding unexplained features of the instrumentalities in our field of engineering life. I presume that none of us had thought of it as "research" Research at that time rested in my mind as something leading up to a multiple volume treatise like Faraday's "Experimental Researches", Maxwell's "Electricity and Magnetism" or Helmholtz's "Sensations of Tone", or perchance culminating in revolutionary discovery, like Faraday's researches in electromagnetic induction or Newton's investigation of motion and gravitation Our activities were simple investigations carried on to satisfy inquiring minds and executed in the daily life of a group of students preparing themselves for their professional work If these activities were research, it seemed an inevitable conclusion that research is a part of engineering education The conclusion is sound Research not only has a function in engineering education, but it is more, it is an integral part of properly conceived engineering education

---

[1] Address delivered at opening session of thirty-ninth annual meeting of the Society for the Promotion of Engineering Education, Lafayette, Indiana, June 17, 1931.

The recorded early part of the lives of Michael Faraday, Joseph Henry, George Stephenson, Alexander Holly and a host of others to whom we are indebted for the present status of engineering and the engineering industries shows plainly that the principal quality of their education, which primarily was self-education, arose from just such activities as were characterizing the electrical engineering laboratories in the University of Wisconsin to which I have referred It was truly education to such men—in some instances almost the only education they secured in youth, it also was research of moderate order and Dr Thurston was right in dubbing as research the activities going on in our Wisconsin laboratories

However, I prefer to call such rudimentary or elementary research an exercise of the spirit of inquiry or scientific curiosity, and make the latter a definite feature of engineering education, to which it pertinently belongs Phenomena and their interrelations command the engineering life, which is thus distinguished from the more arithmetical life of a merchant-prince or a country banker Inquiry regarding phenomena may be analytical in character, calling for pencil and paper It perchance may be philosophical in nature, calling for argument or debate But such inquiry is most fruitful when originally unfolded in the laboratory, or the validity of its analytical or philosophical conclusions have been tested there The laboratory of physical experiment is an eminent aid to the analytical and philosophical inquiries by affording pragmatic tests of the soundness of original analysis or philosophical synthesis, besides also of itself being a place for original discovery. Words alone are not enough The individual must exercise the habit of seeing and investigating for himself.

Joseph Henry one time nicely stated in words one of those platitudes that ought to be commonplace elements of every engineering teacher's processes, but too often are forgotten because they are only platitudes "There is a great difference between reading and study, or between the indolent reception of knowledge without labor, and that effort of mind which is always necessary in order to secure an important truth and make it fully our own" The crystallized hindsight of the printed text-book page and the conventional classroom lecture do not alone stimulate most minds to the necessary effort; but a ready instrument for such stimulation lies in the practice of investigation carried out under sympathetic counsel and direction by suitable leaders For sufficiently advanced students the seminar consisting of a student group, carrying on research under the guiding influence of lectures by a professor, mutually discussing their inferences and conclusions, also perhaps testing them in the laboratory, and writing dissertations summarizing results of their inquiries, is a practice of proved success in higher education

This is an age when most intellectual individuals prefer to command a great project rather than to inscribe a Greek verse, and this mental attitude has brought large rewards to the common people of the world as well as to the individuals who have dared on their behalf to deal with nature in new ways The fine arts and the decorative arts lose no distinction by sharing their pedestal with the products of creative-minded men who concentrate their attention on those things that contribute to the physical welfare of the human race Indeed, this sharing has brought to the graceful arts an incense of appreciation which has steadily broadened without sacrifice to its depth The scientists and engineers lead the van of the daring ones, but none will "dare" except he possesses an investigatory spirit and a resourceful mind. If formal education is to do much for such men in their youth, as we claim is a prime object of engineering education, the education must be directed to research of the varieties that encourage the spirit of inquiry and add to the store of intellectual and manipulative resource Lacking this, our disciples will not be among those who lead in the conquest of unknown regions and the marginal areas that face the engineering industries—which conquest may, decade by decade, confer yet larger and more widely-spread benefits on the common members of the human race Book learning, and instruction about facts of nature and man, are a background for stimulating intelligence and arousing ambition, but alone they are static and insufficient to stiffen the students' backbones and inspire them to balanced initiative, originality and self-reliance

The boon of such stiffening and inspiration, along with lessons in the joys of accomplishment, may be conferred on our students by leading them into the paths of research, minor and easy paths at first but becoming more excitingly difficult according to the advancement of each student. The achievement of this process is difficult Nevertheless, experience shows that the effort is worth while and observation indicates that the greatest centers of engineering education have become great and attractive to ambitious students because of willingness in those centers to make the effort.

Such reflections are fully supported by experience and observation They may be verified by examples The department of electrical engineering at the Massachusetts Institute of Technology and the like department at Cornell University share the honor of directing the earliest established formal curricula in electrical engineering The world's practice in this field has largely grown from these two examples. These early curricula were both established in the academic year 1882–3, one late in 1882 and the other early in 1883, and students in each first received degrees in course in June, 1885 In those days the action of electrical machinery was not altogether understood and often was crassly misunderstood, the characteristics of electric circuits under transient conditions had not been extensively explored, equipment was meager, instruments for measurement were inadequate, text-books were not available, and instruction, as a matter of necessity, was by the seminar type of study and investigation carried on by students under direction of the professors Some lectures were provided, but mostly the students studied the character of machines, instruments and circuits in the laboratories and reflected on the possibilities and consequences of modifications Much extemporization was exercised to demonstrate the results of changes in combinations. If a machine or device was lacking and could not be borrowed in some form, students made it. The data for complete mathematical analysis were lacking, and the possibilities of many forms of analysis, now in common engineering use, were only showing over the horizon as an absorbing stimulus to individual ambition and study The setting was one of vital and whole-souled intellectual interest Examining the rosters of men who were in the early classes of these two courses discloses a notably high proportion of their members who became of high place in electrical engineering

At a somewhat earlier date President Morton, Professor Thurston, Professor De Volson Wood and their associates at Stevens Institute of Technology were developing a similar situation in mechanical engineering. In that period Professor Thurston established a laboratory for investigation in the engineering sciences. Nowadays we would call it a research laboratory. These men were trail breakers in mechanical engineering education, and it may be significant that the roster of early graduates of Stevens now reads like a "Who's Who" in Mechanical Engineering The influence of those graduates during the unfolding of American industries has been tremendous and magnificent Still earlier, a devoted group at Rensselaer Polytechnic Institute worked through a similar development period in civil engineering education, and the large influence ultimately impressed by their students on American engineering is sufficiently well known

These examples are typical and selected without overlooking the meritorious results from other early engineering schools and curricula established in the last half of the nineteenth century Perhaps the interesting influence in chemical engineering of the courses of study in that branch that came into being a quarter of a century ago, or thereabouts, partly arises from a similar set of conditions growing out of applications of science in newly growing industries, which stimulated inquiring minds and led instruction through the paths of investigation

Many of our present students will be inspired to mature performances just as notable as those of their predecessors, but can we unqualifiedly assert that those thus achieving will comprise an equally large proportion of the present generation of students as in the examples above referred to? I think that it is generally agreed that the answer to this question is "No" It may be lightly commented that now there are more students in the engineering schools and that they are less ambitious and scholastically less well prepared to pursue their courses of study in engineering, but this is not a sound rebuttal There now are more engineering schools and many more professors employed in them, compared with the numbers at the close of the nineteenth century Are we ready to concede less intellectual vitality, devotion and ability in the individuals of our group of teachers than in the corresponding group of forty years ago? That would be an ignominious confession In my opinion there is as much intellectual vitality, devotion and ability per unit in our group to-day as there was forty years ago. The information disclosed in Vol I of the Report of the Board of Investigation and Coordination of this society supports the opinion:

> The educational standards of the present group of engineering colleges taken collectively compare favorably with those of all other equally comprehensive groups of undergraduate colleges This statement holds for the adequacy of their physical facilities, the number and qualifications of their teachers, the level of their ad-

mission requirements, the content and rigor of their curricula, the soundness of their scholastic standards, the extent and quality of their research activities, and their expenditures per student

I will add the comment that an investigatory spirit and achievement are more important attributes for the engineering teacher than higher degrees, and we must fix our faces unwaveringly against a policy, now somewhat established in the colleges of arts, of making staff appointments from doctor's degrees attached to second-rate men in preference to selecting first-rate men without the doctorate when the first-rate man can not be secured along with the doctorate You must remember when I say this that I am an active proponent for the advantage that graduate study confers on those who go into teaching and also for many of those who go into industrial life But there are good reasons why a doctor's degree, as a badge, is not an important requisite for a teacher of engineering subjects The man with neither fire nor industry is but loss in this occupation Even where location and means preclude formal organization of research, this character in the teaching needs be kept foremost in the minds of the teachers The opportunity for its exhibition is not lacking in any of our properly administered engineering schools It should be the object to saturate our students in an aura of resourcefully productive thinking and doing Plenty of this aura must emanate from the spirit of those who teach the classes, to be effective on the students, and not be the outcome alone of those who direct departmental affairs or those who confine their endeavors to formal research Formal and external badges of learning, however carefully conferred, can not compensate for deficiency of these qualities in the teachers

Observation leads me also to believe that our entering students are proportionately as well prepared to pursue their engineering studies as corresponding students were forty years ago At the present time the number of listless students is numerically greater, but I doubt that the proportion of such in the total is greater, or that the preparation and ambition of most of the students are relatively less satisfactory, or that the proportion of adventurous intellectual spirits is less

Students suitably infected with the spirit of investigation will smilingly carry heavy allotments of mental and physical work and ingratiatingly intimate a willingness for more About eighteen years ago a large industry offered to the department with which I am related a considerable annual sum of money to be used over a period of improving our advanced instruction and research. We embraced the opportunity to keep the research so much in the consciousness of junior and senior students, as well as graduate students, that it has had a notably stimulating influence Those of us in that setting think well of the result of this coordination of the teaching and research.

It also may be suggested that the field of the unknown has been exhausted in engineering and that there is nothing left for the inquiring mind, but that comment is only made by those who do not observe for themselves It is sufficient to answer Look around and observe, study the development of engineering in the past and present and you will discover a speed and width of the front of growth in all branches of engineering which now rivals if not excels any previous era

This is a period suffering from a flood of predigested text-books, reliance on conventional laboratory assignments and presentation of formal lectures The cry is made that these processes are necessary in order that the students may learn all that they should learn, and that there is no time left over for cultivating an investigatory spirit My answer is that resourceful foresight and self-reliance (set against pepsinized hindsight and common industry) will always win in the end, and we develop the winner when we develop investigative spirit and resourcefulness, even if some store of secondary facts is neglected for lack of time Our situation is illustrated by the old ditty

Could man but be sure that life would endure
As of old, for a thousand long years,
What things he could know, what deeds he could do,
All without hurry or care

Recognizing that life is short we must reconcile ourselves in education to selecting the most serviceable of various possible processes, remembering that the sweep of time does not permit us to embrace more In making our choice of processes, however, we must try to make sure that the choice is of the most serviceable

Albert W Smith, known to most of you as former director of Sibley College, and before retirement as acting president of Cornell University, but to some of us known earlier as a remarkable teacher of machine design, held that no teacher should teach from a text-book written by another This is a way of saying that the work of the engineering teacher should constantly grow under his hand, and also is a way of stating that the inquiring, forward-looking mind and the spirit of investigation are essentials to foremost engineering teaching Unhappily, text-books written in that spirit often are received coldly by the teachers, as "too hard," and a preference is exhibited for the predigested, backward-survey types. This has a temporary justification among teachers loaded with an excess of classroom assignments, but it is one of our collective duties as a society to show to college administrative officers a better way Students who possess ambition and courage to study, reflect and learn under guidance ultimately may go far, but those who insist that they are paying their money "to be taught" are out of place in an engineering school

Can any one doubt that the influence on their students and in engineering education of, for example, Irving Church, Mansfield Merriman and George Swain was in large part due to their resourceful originality and investigative spirit, standing foremost day by day as an example before their students? Engineers must deal with physics, economics and psychology, materials and forces, the philosophy of wealth (in the technical sense), and man It is not a mental accumulation of facts alone that fits young men for doing this, but an understanding of interrelations of facts and the methods of detecting and identifying facts is of the essence Our theories of action, relating to man or to mechanical design, are formulated from relatively few fundamental facts associated with a multitude of keenly recognized permutations of their relationships

Detecting and identifying facts and discovering their varied relationships is research Properly directed research is a potent instrument to arouse the ambitions and exercise the reasoning powers of students It also teaches them to use foresight in planning and a responsibility for carrying through It exposes them to early observation of the many faceted purposefulness and everlasting persistence of nature It may result in important discoveries, which is another function Universities and colleges (including engineering schools) have several functions to perform One of these is the search for truth, and in science we interpret this as seeking for new facts, disclosing previously unobserved interrelations, and more fully illuminating facts and relationships previously announced but still partly obscure In engineering we weave this function into a fabric along with economics and psychology and have a still more complex compass of research than characterizes any exclusive science The field is magnificent and must be cultivated Research is an inspiring part of the life of colleges The spirit for establishing research laboratories and foundations in engineering schools is a presage of good educational spirit in the schools The proper interpretation of the situation is important.

We must remember that universities and colleges have education for their prime function, and it being my thesis that research is part of engineering education, students of suitable advancement should be invited into the research precincts to there take up tasks To set up research laboratories and libraries and bar out students of suitable advancement from pursuing work therein would be inappropriate to university ideals and to the weaving of the best fabric of engineering education Research laboratories, dedicated to and carrying on fundamental research of high order, gloriously serve the advancement of mankind through their investigations and discoveries When so directed that the atmosphere of independent achievement is allowed to spread into the haunts of upper-class students, as well as to graduate students and teaching staff, they collaterally make large contributions to educational results and thus their value to civilization is multiplied

THE UNSOLVED RIDDLE OF THE SOLAR SYSTEM

By CARR V VAN ANDA

NEW YORK, N Y

> The public is being played upon and utterly misled by the dreamery of the rival mathematical astronomers and physicists —*Professor Henry E Armstrong, in Nature, Aug 23, 1930, p 275*

DR. HAROLD JEFFREYS, university lecturer in mathematics and fellow of St John's College, Cambridge, expounds in *The New York Times* of May 3 his newly developed theory that the planets of the solar system owe their origin to a shearing collision between the sun and another star The article is a summary of two papers which Dr Jeffreys contributed to the *Monthly Notices* of the Royal Astronomical Society, Vol LXXXIX, Nos 7 and 9, 1929 Because this theory, in contrast with its original rather unexcited reception by scientists, is now presented as something of exceptional importance, and because the present version indicates, as the original papers did not, an apparent final abandonment of Sir James Jeans's famous development of the "tidal theory," by the man who was long Sir James's chief supporter, an examination of both theories may prove to be worth while

The essential feature of the new theory is that at the end of the collision there was drawn out between the two bodies a ribbon of matter in which circulation had been set up by their opposed velocities This ribbon presently broke up and the parts condensed into planets, endowed with rotation by the circulatory motion of the ribbon Dr. Jeffreys assumes that the mass of the star was comparable with that of the sun and that their surface of separation approached the center of the sun within a distance equal to about half the sun's radius In the absence of any assignment of definite mass and radius to the star, we shall in this discussion provisionally take them as equal to the sun's

In the first of the original papers Dr Jeffreys says that "the velocity of escape of a particle from the sun's surface is 450 km/sec," and that the relative velocity of the sun and the colliding star would be of this order, or 400 km/sec This figure for relative velocity still stands, two years later, in his article in *The New York Times* Parabolic velocity for a particle at the surface of the sun is 620 km/sec, not 450 km/sec, as Dr Jeffreys states, and for a large body like a star it would be much greater—about 875 km/sec in the case here considered So we have the parabolic velocity for a particle understated by 170 km/sec, the larger parabolic velocity for the star ignored, and a relative velocity assumed that is less than half the actual parabolic velocity It is difficult to understand how Dr Jeffreys reached the conclusion that such planets as ours could have emerged from conditions which would imply that the star was a permanent member of the solar system. If the laws of motion of two bodies did not provide sufficient evidence of such an association in this case, we should still have Dr Jeffreys's word for it Discussing the tidal theory, on page 26 of the second edition of "The Earth," he says "But the velocity of the sun relative to the star was at all instants *greater* than the parabolic velocity, otherwise the sun and the star would still be associated" The necessity for a larger relative velocity is made strikingly apparent when, taking it at 400 km/sec, it is found that the collision would have established the sun and the star in an elliptic relative orbit, of which the major semi-axis would have been less than the sun's radius In such an orbit the sun and the star would have tended to revolve in contact until they merged into one body—a process likely, however, to have been disturbed by internal reactions The possibility that in the collision theory Dr Jeffreys may have had in mind the sun in another than its present state is excluded by his assignment to it of its present mass and radius

Dr Jeffreys has made an important correction as to the duration of the collision In the original paper this was given as about half an hour, arrived at by dividing the radius of the sun by the relative velocity—an error that leaps to the eye. He now writes "The star would travel the diameter of the sun and be clear again in about an hour." This greatly affects the planet-forming mass that "trailed off after the star," at the end of the collision, and other elements of the problem as well. He gave this mass originally, and gives it now, as equal to 1/500 of the mass of the sun, but, by his own formula for one of its factors, as will be shown below, doubling the distance traveled by the star during the collision would double the thickness and mass of the planetary ribbon It would also double the volume and mass of an equivalent sphere of the same density

The rotational period of the "equivalent sphere" is employed by Dr Jeffreys to show that his collision would impart a sufficient rotational period to the great planets One of the chief difficulties in all theories of the origin of the solar system is that of securing for the planets, originally fluid, their observed rotation, or, indeed, any rotation at all It is because he thinks it offers means of solving this difficulty that Dr Jeffreys now revives the collision theory, 180 years old, of Georges Louis Leclerc, Comte de Buffon, who, in addition to theorizing about everything, translated Newton's Fluxions into French, and thereafter, quite appropriately, died of calculus

Dr Jeffreys writes the equation

$$\pi\rho a^2 d\, du = \frac{8}{15}\pi\rho b^5\omega,$$

where the left-hand member is the angular momentum of the layer of matter displaced by the collision to form the planetary ribbon, the axis being taken as passing through the center of mass and perpendicular to the general motion, and the right-hand member is the rotational angular momentum of the "equivalent sphere", ρ the density, a the radius of the sun, d the thickness of the layer, whose mass varies with it; u the relative velocity of the sun and the star, b the radius of the sphere and ω its angular velocity This equation reduces to

$$\omega = \frac{a^2 d^2 u}{\frac{8}{15} b^5}.$$

On his original calculation this led to a rotational period of 8 hours for the "equivalent sphere" There is, however, in the published paper a curious tangle of errors that seriously affects his result In determining d, the radius of the sun is treated as the diameter of the interface formed by the star's passage through the sun—or, as Dr Jeffreys puts it, the distance traveled by the star (within the sun's boundary, of course) during the collision—but it is also treated both as the radius and as the diameter of the interface in factors which determine b, and, in raising b^3 to b^5 from the equation $b^3 = \frac{3}{4} a^2 d$, the numerical coefficient $\frac{3}{4}$ has been carried unchanged into the denominator of the formula, making 4/3, instead of $(4/3)^{5/3}$, a factor of the angular velocity. There is, besides, a considerable error in the final computation, due to the use of round, instead of accurate, numbers. The correction of the errors mentioned reduces the period to about 6½ hours, but is of no consequence while the assigned relative velocity remains so small as to assure the permanent association of the sun and the star

Dr Jeffreys is free to assign a larger relative velocity, but if he does so he will diminish the duration of the collision, increase the angular velocity of the "equivalent sphere," and correspondingly reduce its rotational period, the approximation of which to the 10-hour rotational periods of the great planets he seems to consider important When all corrections are made, including the necessary increase in the relative velocity and the substitution of the true dimensions of the interface—these, as newly assigned by Dr Jeffreys, are *still* incorrect—it is found that the rotational period of the "equivalent sphere" falls to about 2½ hours, or only one fourth the value aimed at

Even if Dr Jeffreys's assigned values had been such as to make the rotational period of the "equivalent sphere" equal to the observed average rotational period of the great planets—which would have required the relative velocity of the sun and the star to be less than 220 km/sec —the plausibility of the demonstration would have been illusory For it is readily shown that if the mass and the angular momentum of such a body had been distributed proportionally to form several spheres, including the great planets, the rotational periods of the latter could not have been, as they are now, nearly equal, but would have differed widely, and all would have been much less than they are observed to be

Substituting in the formula for the angular momentum of the planetary ribbon the corrected values of various factors, which the present discussion has shown, or will show, to be necessary, the least possible value for the relative velocity—875 km/sec, in the case considered—would have given to the planetary ribbon an angular momentum of 8 13(10^{46}) c. g s units. Neglecting the insignificant participation of the smaller planets, this is 10¼ times the total rotational angular momentum of the four larger planets, which is, by a computation that necessarily leads to a highly excessive result, 7 94(10^{45}) c. g s units. The rotational angular momentum of each of the great planets is computed as if it were a homogeneous sphere of the same mass and mean radius as the planet Thus the considerable increase of density toward the center is not taken into account. The true rotational angular momentum of each planet and the total for all the planets are therefore much less than they are computed to be. If data existed for an exact computation, the ratio 10¼ might be doubled, or even tripled. Taking the mass of the ribbon as equal to about 1/500 of the sun's (why this is correct, in spite of Dr. Jeffreys's conflicting data, will be shown below), it would have contained a little less than 1½ times the mass of the great planets Thus a minimum of more than seven times their total rotational angular momentum would have been available for them. Its distribution in proportion to mass—any other distribution would have to be accounted for—would imply that the planets came into being rotating so fast that their equatorial surface velocities of rotation would have exceeded the parabolic velocities, or so-called "velocities of escape" The result would have been for Jupiter 1¼ times, for Saturn 2 4 times, for Uranus 9 6 times, and for Neptune 8 7 times the parabolic velocities at their respective equatorial surfaces The effects of such a distribution of a little more than two thirds of the ribbon's angular momentum among the great planets, if it could occur, are shown in the subjoined table The data used in the calculations are those given in Russell, Dugan and Stewart's "Astronomy"

	*Angular Momentum of Rotation		†Velocities Compared		Rotational Period	
	Observed, less than	By theory	Rotational at equator, by theory	Velocity of escape	Observed (Hours)	By theory (Minutes)
Jupiter	6 59	39 8	74	60	9 83	98
Saturn	1 28	11 9	87	36	10 23	66
Uranus	04	1 8	202	21	10 7	13
Neptune	03	2 1	200	23	15 ?	13?
	7 94	55 6				

* The numbers in the first two columns, multiplied by 10^{45}, represent c g s units

† The numbers in the third and fourth columns represent kilometers per second

The great disparities revealed by the table show that the fundamental assumptions of the theory prohibit the formation of planets It is possible that Dr. Jeffreys's formula overstates the angular momentum of the planetary ribbon But any reduction which might be effected by correction of the formula would probably be more than offset by the reduction that an accurate computation, if it were possible, would make in the rotational angular momentum of the great planets.

If we accept Dr. Jeffreys's formula for the angular momentum of the planetary ribbon, a relative velocity of 125 km/sec. for the sun and the star would have enabled it to supply to a system of planets the total rotational angular momentum of our system In his recent article Dr Jeffreys said his theory was supported by new mathematics only recently made available If he has any mathematics that will reconcile the necessary reduction of the relative velocity to 125 km/sec, to equip our planetary system with the correct rotational angular momentum, and the equally necessary increase of that velocity to 875 km/sec, to dissociate the sun and the star after the collision, he possesses something that reduces the theory of relativity to insignificance as a modifier of Newtonian mechanics

If the difficulties thus far described could be removed, would the mass of the supposed planetary ribbon be adequate to the formation of our planetary system? This mass is fixed by a quantity which, as Dr Jeffreys points out, has been "determined by experiment"—the pure number 002, coefficient of a product of factors of the problem determining the thickness of the layer to which the opposed velocities of two fluids may communicate vorticity, when the difference of the velocities is high, as it is in this case The mass of the ribbon is the product of the area of the interface and the thickness and density of the displaced layer The momentum communicated to the layer in time t is $002\rho u^2 t$ per unit area, where ρ is the density, which is taken as approximately equal to the mean density of the sun But ut equals the distance traveled by the star during the collision To this quantity Dr Jeffreys originally gave the value a Substituting this value in the formula for momentum, he found that a velocity u would be communicated to a layer whose thickness was $002a = d$ Using this value of d in his formula for the mass of the layer, $\pi\rho a^2 d$—here, as will be seen, the diameter of the interface has been doubled, without explanation—that mass becomes $002\pi\rho a^3$ Dividing this by the mass of the sun, $\frac{1}{3}\pi\rho a^3$, the mass of the planetary ribbon comes out 1/666 of the mass of the sun, instead of 1/500 Since he now doubles the distance traveled during the collision, making it $2a$, instead of a, he doubles the value of ut, and so doubles the thickness and mass of the layer The mass should now be 1/333 of the sun's, instead of 1/500

There is, however, another discrepancy to be considered, which also affects the mass of the planetary ribbon Dr Jeffreys says of his estimates, "All rest on the assumption that the area of contact had a radius comparable with the radius of the sun" So he writes the area of the interface equal to πa^2, giving it a radius equal to that of the sun But the interface, whose center he places approximately at the midpoint of the sun's radius, would have a radius of about half the chord perpendicular to the sun's radius at that point, that is, about $866a$. This is comparable with a, of course, but if we substitute its square for a^2 in πa^2, we reduce this factor of the planetary mass to its proper value, which is three fourths of that given by Dr Jeffreys The quantity ut is now the diameter of the interface, or $1\ 73a$, and the momentum will impart a velocity u to a thickness $00346a = d$ Using this new value of d in the formula for the mass of the layer, and remembering that $75a^2$ must be substituted for a^2, the mass of the layer becomes $0026\pi\rho a^3$ Dividing this by the mass of the sun, we find the final corrected total mass of the planetary ribbon to be equal to 1/513 that of the sun This is practically the value Dr Jeffreys gave two years ago, which could not be obtained from the data he gave then, it is also his present value, which likewise, can not be obtained from the data he gives now, except with the corrections here indicated

The curious agreement between Dr Jeffreys's result and the one here derived, for the mass of the planetary ribbon, may have been due, in the first instance, to his taking the ratio of the two masses as roughly equal to his original 1-to-500 ratio of d to a, or to an accidental canceling of errors and omitted factors in his first calculation, but the fact that he left this value unchanged in his recent article, notwithstanding the doubling of the distance traveled by the star during the collision, suggests that a revised calculation has led him to substantially the same result as that found here In any case, it appears that a mass equal to 1/500 of the sun's would have been displaced to form the planetary ribbon, if the interface penetrated the sun to the midpoint of its radius and the average density of the matter adjacent to the plane of the interface equalled the mean density of the sun On the latter point Dr Jeffreys says "Its density would be comparable with the mean density of the sun" (second paper, p 737), and he had previously taken the final density to be "the same as the initial one" (first paper, p 640) These and other parts of his discussion indicate that in estimating the penetration of the interface and the average density in its neighborhood he has taken into account the compression that would occur during the collision

The computed mass of the displaced layer, although it is about 1½ times the mass of our planets, is nevertheless inadequate to the formation of our system As the two bodies began to separate, the layer, suddenly released from compression, would expand transversely and much of it might be lost in interstellar space, and under various conditions, the planets, if any were formed, might go to the star or be divided between the sun and the star Moreover, it will appear when Jeans's theory is discussed—and largely by Dr Jeffreys's own contributions to that theory—that the formation of our system of planets would require the extraction of much more than their mass from the sun The collision theory, like the tidal theory, requires not only matter enough to form the planets, but an allowance for such matter as would fall back into the parent body and an additional allowance for the "resisting medium," whose function it is to modify the highly eccentric original orbits of the planets Each of these allowances, in the tidal theory, requires, as we shall see, a mass about equal to the mass of all the planets, and these requirements, at least for the resisting medium, can not be much less in the collision theory

If the planetary ribbon "stretched out all the way from the sun to the star," "or three times the radius of the sun," as Dr Jeffreys says, there is no apparent reason why, at its rupture, a system of planets should not have formed around the star as well as around the sun If the division of the ribbon between the two were equal and none of the matter were lost in interstellar space, the part available for the formation of the planets in the solar system could hardly have been more than 1/1000 of the sun's mass, or almost exactly the mass of Jupiter

It should perhaps be noted that when Dr Jeffreys derives the duration of the collision from a division of the diameter of the interface by the relative velocity, we have taken his meaning to be something that might be called "effective duration" Actually, from the moment of making to the moment of breaking contact, under the conditions laid down, a star of equal mass and radius with the sun would travel twice the diameter of the interface But the duration of contact and the density of the displaced layer, which has been averaged and treated as constant, both vary from zero to a maximum value for different parts of the interface, so as to affect the same mass as if the density were constant, the area of contact that of the interface, and the duration very nearly that required to traverse the diameter of the interface

JEFFREYS'S WORK ON THE TIDAL THEORY

It may be instructive to consider for a moment Dr Jeffreys in his now abandoned rôle of upholder of Sir James Jeans's theory that the planets condensed from a stream of matter drawn out of the sun by the gravitational power of a passing star, without contact In this theory some restrictions have to be imposed upon the mass and density of the passing star Jeans holds, in the only example he has given, which is "made to order" to fit the theory, that a mass twice the sun's is sufficient, at a proper distance, to draw out of the sun enough matter to form the planets

Jeffreys reduced Jeans's theory to an extremely simple formula Representing the mass of the sun by M, that of the passing star by M', the radius of the sun by a, and the distance between the centers of the two bodies at closest approach by R_0, he wrote·[1]

$$\frac{M'}{R_0^3} > \frac{M}{2a^3},$$

saying "This is the condition that the mass M shall be broken up" It is extraordinary that upon arriving at this formula its author did not at once reexamine its foundations or abandon Jeans's theory For hardly more than inspection is required to discover that, unless M' is much greater and of much higher density than M, R_0 will be so small that a collision must occur If we test the formula, assuming the density of the sun and that of the star to be equal, we shall find that if M' be less than 57 times M, there would be a collision At the latter value of M' the two bodies would make a momentary grazing contact at a point on their normal surfaces We have here neglected the tidal protuberances on both bodies To prevent their contact the value of M' would have to be far greater

Obviously we require a star of higher density, which will permit a more reasonable value for its mass Since the formula is general it should apply to all cases Jeans takes

$$M' = 2M, \qquad R_0 = 2\ 667a,$$

and, grant him the sun he describes, apparently it will be ruptured and matter will be extracted from it These values of M' and R_0 should satisfy Jeffreys's inequality, provided Jeans and Jeffreys are really using the same theory, instead, the least value of M' comes out about 9 5M A star of this mass and of the density necessary to avoid contact with the sun, and with its tidal protuberance, would probably have to be especially created Jeffreys says his formula is the equivalent of each of two inequalities which he has just previously developed, one for a "slow" and one for a "transitory" encounter It is the equivalent of the "slow" inequality, but the equivalent of the "transitory" inequality would have 2 22, instead of 2, in the denominator of the second term. The difference this makes is considerable, reducing the 57M and 9 5M of the above computations to 35M and 8 5M, respectively, but not improving the prospect of finding the required star among such stars as are known The encounter that would produce planets is described as lying between the "typically slow" and the "typically transitory" Unfortunately, Jeffreys bases his "transitory" formula upon an arbitrary requirement that the velocity of the outermost particle of the tidal stream, at the end of the encounter and relative to the center of the sun, shall exceed the parabolic velocity of a particle at the normal surface of the sun So a large and important part of the stream—the very part from which Jeffreys says the planets must be formed[2]—having originally a postulated parabolic velocity relative to the star, and being now endowed with an additional more-than-parabolic velocity, this time relative to the sun, would escape from both the star and the sun and be lost in space

---

[1] "The Earth," second edition, 1929, pp 24–25

To illustrate the working of the theory, Jeffreys offers, as Jeans does, only a single example In this he gives the sun nearly 1,000 times its present radius, the star 4 times the sun's mass, and makes the distance between the centers of the two bodies, when rupture of the sun ends, only 1½ times the sun's radius Applying a formula derived from Jeans's work to determine the height of the tidal stream at periastron, it appears that Jeffreys's star, besides having to be of very high density, would be enveloped by the stream—bombarded by part of it, left behind by other parts—and possibly would acquire a system of planets for itself from the later parts having less than the assigned parabolic velocity Whether such a sun as that described would acquire a system of planets is not important, for on the next page of "The Earth" (second edition) Jeffreys virtually admits—because, of course, of the new view of the age of the earth—that our sun could not have been in the condition described, when our planets were formed

Thus Jeffreys's mathematical presentation has never offered the possibility of the formation of planets from the sun we know Further, we see that Jeffreys and Jeans have all along been in disagreement, although, apparently, neither knew it until recently, for, until 1929, when the second editions of both Jeffreys's "The Earth" and Jeans's "Astronomy and Cosmogony" were issued, they were felicitating each other on having arrived at the same results Agreeing or not agreeing, the results obtained by both have now been abandoned by Jeffreys

JEANS'S WORK ON HIS OWN THEORY

It is well known that when Jeans proposed the tidal theory he assumed that the "birth" of the planets had occurred early in the history of the sun, to which he therefore assigned a radius equal to that of the present orbit of Neptune Recent estimates of the age of the earth, placing it at a few thousand million years, a brief period compared with the age now attributed to the sun, constrained both Jeans and Jeffreys to the conclusion that the size of the sun could not have been appreciably greater when the planets were evolved than it is now Neither Jeans nor Jeffreys offered new proofs to meet this new condition, although new proofs were very much needed In the 1929 edition of Jeffreys's "The Earth" and in both the 1928 and 1929 editions of Jeans's "Astronomy and Cosmogony" there are paragraphs reducing the sun of the encounter to its present dimensions, but no change is made in the mathematics and reasoning, which clearly apply only to a sun of much larger radius and much lower density So Jeans's work can be studied only in his original example

Nowhere in the published works of Jeans and Jeffreys is any estimate given of the quantity of matter extracted from the sun during the tidal encounter, so that we have no assurance that after rupture occurred enough matter would be supplied to form our planetary system Let us attempt a provisional estimate for Jeans's example

Jeans gives no simple formula, as Jeffreys does, he does not even assemble the data in any one place These must be searched out in the pages of his "Problems of Cosmogony and Stellar Dynamics" The quantities required, together with the numbers of the pages of the book on which they are to be found, are as follows.[3]

Mass of the sun, p 277	$M = 2(10^{33})$ grams
Mass of passing star, p 277	$M' = 2M = 4(10^{33})$ grams
Periastron distance, p 284	$R_o = 1\ 2(10^{15})$ cms
Radius of the sun, p 278	$a = 4\ 5(10^{14})$ cms
Critical distance between centers of the two bodies, when rupture of sun begins, p 278	$R = 1\ 27(10^{15})$ cms
Length of major semi-axis of sun in excess of a, at end of encounter, p 130	$2fM'a/R_o v^2 = 2(10^{14})$ cms
Relative velocity of M and M', p 283	$10(10^5)$ cms /sec
Time of encounter, p 130	$2R_o/v = 2\ 4(10^9)$ seconds (about 76 years)
Constant of gravitation	$f = 6\ 66\ (10^{-8})$ c g s units.

By the formula $2fM'a/R_o v^2$ we find that at the end of the encounter, which is taken to be at closest approach (periastron), the apex of the tidal stream is $2(10^{14})$ cms above the normal surface of the sun, or $6\ 5(10^{14})$ cms from the center of the sun Let us assume that the tidal stream was separated from the sun where the attraction of the sun and the star, at periastron, just balanced. This is about $5(10^{14})$ cms from the center of the sun The distance thence to the outer limit of the stream is $1.5(10^{14})$ cms.

---

[2] "Only the parts first drawn off can be permanently detached from the sun"—"The Earth," second edition, p 20

[3] An attempt has been made to reconcile the notations of Jeans and Jeffreys These are almost identical, but Jeans is not always consistent, *e g*, using R both in the sense here conveyed and in the sense of R_o. For the a used here he uses r_o, and employs a for extensions of r_o, that is, for the major semi-axis of the tidally distorted sun. The *formula* $2fM'a/R_o v^2$ has been obtained by clearing the first term of Jeans's equation of its denominator and inserting in the numerator the gravitation constant, which Jeans here omits but afterward restores.

At the moment of rupture of the tidal cone the radius of a plane section of the solar spheroid at right angles to the major semi-axis and distant from the point of rupture 1.5(10^{14}) cms would be about 2(10^{14}) cms. As the sun approached periastron and matter continued to pour out, the tidal cone would be elongated and narrowed. So then, if we take a cone with radius of base 2(10^{14}) cms and altitude 1.5(10^{14}) cms, its volume should exceed that of the matter extracted by the star's gravitational pull, although its shape would not be that of the tidal stream.

This volume is 6.285(10^{42}) cm^3. Jeans gives the density of the tidal stream, or "filament," as he calls it, as 5.5(10^{-13}) gm/cm^3. Multiplying this by the volume, we obtain the mass of the matter extracted, 3.456(10^{30}) grams, which is about 1/580 of the mass of the sun, or about 1.3 times the mass of all the bodies now revolving around the sun.

It has been pointed out in the discussion of the collision theory that in order that a planetary system may be formed, much more than its own mass must be extracted. The "resisting medium" necessary, according to the theory, to reduce the original eccentric orbits of the planets to their present shapes must be taken into account. According to Jeffreys,[4] it would be "reasonable" to compare the mass of the resisting medium with that of Jupiter, which is nearly three fourths of the mass of all the planets together. Since it is now known that there is a ninth planet, and possibly other planets, beyond Neptune, it may not be unreasonable to take the mass of the resisting medium as equal to that of all the planets together.

The extracted matter is also subject to other losses. It is agreed that much of it must have fallen back into the sun. The theory derives the rotation of the sun from this source, and Jeffreys[5] estimates that a mass at least equal to that of Jupiter would be necessary for this purpose. He calculates, of course, effective mass. Since it is probable that much of the matter that fell back would be ineffective in producing rotation, this estimate, too, might well be raised to an amount equal to the mass of all the planets.

A source of possible loss not considered by either Jeans or Jeffreys is radiation pressure. The importance of this would depend upon the conditions of the encounter. This pressure would be effective, if at all, against the resisting medium, which is supposed to consist of the lighter parts of the tidal stream, greatly rarefied by diffusion. The mean density of a comet has been estimated at 1/230,000 that of air,[6] which makes it 5(10^{-9}) gm/cm^3. It is a commonplace that when a comet approaches the sun the radiation pressure of the latter drives off in the opposite direction the matter emitted by the comet. Jeffreys[7] tentatively offers the hypothesis that the density of the resisting medium might be as low as 4(10^{-15}) gm/cm^3, which is about 1/800,000 that of a comet. If radiation pressure from the star, or from the star and the sun combined, drove the resisting medium away, the cosmogonists would have to find some other means of reducing eccentric orbits.

So it appears that the various elements of the tidal theory require the extraction of hardly less than three times the mass of the planetary system to assure its formation. We have, therefore, a deficit of 1.7 times the mass of the planets in Jeans's theory. Actually the total mass extracted from the sun would probably be much less than the mass of the planets, and the deficit, therefore, so much the greater. For, in order to give the theory every chance, we have chosen a crude method of estimate intended to give a result far in excess of any mass that could be extracted by tidal forces alone. Even if more matter than we have here allowed could be extracted, the radial velocity of the additional part would be so insignificant that it would probably be only so much more that would fall back into the sun.

Jeans's mechanism for starting his planets in revolution around the sun is contradicted by himself. On page 284 of "Problems of Cosmogony," he "supposes" that the tidal filament is set in motion so that it rotates as a *straight* line around the sun with an angular velocity of 4(10^{-10}). This would give, at a distance from the sun's center equal to 2.1 times the radius of Neptune's orbit, "the transverse velocity appropriate to the description of a circular orbit," so that "planets formed at a less distance than this would describe eccentric orbits."

But he has previously shown that the stream of matter can not rotate in a straight line. After the end of the encounter it is bent around by the star's gravitational pull into the shape of a boomerang. Nothing is given to show that the lagging parts of this curve would ever acquire the transverse velocities necessary to maintain orbits around the sun.

If the theory rested upon so insecure a basis when Jeans fitted to it an imagined sun, so moulded to his purpose that probably such a sun never could have existed in reality, how hopeless it becomes when applied to the sun of a few thousand million years ago that did not differ appreciably from the sun we see to-day. When we compute the parabolic velocity for the present sun and a passing star of twice its mass, at distance $R_0 = 2\,{}^2\!/_3 a$, and add 22 per cent. for safety, as Jeans did in his example, the required relative velocity of sun and star rises to 800 km/sec Such an encounter might cause a convulsion, or a series of convulsions, in the sun, but the most optimistic cosmogonist could hardly expect it to produce planets according to the tidal theory in its present form

---

[4] "The Earth," 1929, p. 60.

[5] *Monthly Notices*, R. A. S., May, 1929.

[6] Russell, Dugan and Stewart, "Astronomy," Vol. 1, p. 480.

[7] "The Earth," second edition, p. 60.

Gravitation requires time to raise any considerable tidal elevation Jeans's theory could be effective, if at all, only when the sun had a very large radius and correspondingly low density, as all his work shows These conditions permit a wide separation of the centers of the two bodies, which reduces the velocity necessary to prevent their union in a system, and so tends to gain the required time

In "Problems of Cosmogony and Stellar Dynamics" and in "The Earth," Jeans and Jeffreys, respectively, professed to rest their case on tidal forces alone, yet there have been manifestations of a disposition to beg the question by tacitly assuming the aid of unnamed forces Both constantly use the term "ejection," which implies propulsion rather than attraction This term has been replaced here by "extraction," as more appropriate to a purely tidal theory "The second star outdoes the sun in gravitational pull, and the top of the [tidal] mountain *shoots* off toward it," says Jeans.[8] The lid has been lifted and the "shooting" has been going on for more than fifteen years in Jeans's one example, but his formulae for distance and velocity at the outer end of the "filament," at the end of this period, represent only gravitational acceleration, taking no account of "shooting"

It may be asked at this point "Should not internal forces be considered in applying the theory to the sun as at present constituted?" To this the answer is Certainly, if any one knows what those forces are and how they would behave under tidal provocation Chamberlin and Moulton, of the University of Chicago, long before Jeans and Jeffreys had begun to deal with the subject, evolved a theory which employed both tidal forces and such internal forces of the sun as they were aware of To their "planetesimal hypothesis," against which Jeans, Jeffreys and many others have directed destructive criticism, Jeans owes the concept of the extraction of matter from the sun by the tidal pull of a passing star If he intends to take over another element of this hypothesis, it will be interesting to see how far new knowledge may enable him to surpass his predecessors in handling the combination As to new knowledge, is it to be found in the bewildering contradictions of the debate, now in its third year in the Royal Astronomical Society and in the scientific journals, about what goes on inside a star? If not, there is always available as an alternative the fundamental principle of Jeffreys's collision theory—which the debaters have not paused to heed—that nothing goes on inside a star that need trouble a determined planet builder Or is Sir James Jeans, indeed, about to abandon his tidal theory altogether and adopt the collision theory of Buffon, as developed by Dr. Jeffreys? We find him expressing the belief, in *The New York Times* of so recent date as June 7, that "the earth is merely a tiny fragment of the sun, which got splashed off [the exact idea of Buffon], almost by accident" The mathematician of Cambridge, rejoicing, no doubt, in an exchange of rôles, would welcome the support of a recruit so distinguished and powerful as the mathematician, poet and dreamer of Dorking

There is no intention of offering here a theory to replace those that have been considered, but perhaps the cosmogonists will permit the suggestion that, in the tidal theory, they have left half the field uninvestigated All have set out on the assumption that the planets must have come out of the sun and that, therefore, the encounter must have been with a star more massive than the sun The sun may have encountered a smaller star of rather low density, quite as easily If the mass, density and velocity of the star could be so nicely adjusted that, as it swung round at perihelion, the outer part would slide off in a barely hyperbolic orbit, leaving a sufficient part of the remainder with less than parabolic velocity, and therefore under permanent bonds to keep pace with the sun, the tidal theorist, at one happy stroke, would acquire the mass necessary for his purposes, with rotation thrown in by the slide Or, suppose the sun had encountered a nebula? What would have happened in that case?

August 7, 1931—It may be interesting to note that after the last question had been written, and before it could be published, an answer had been given *Nature* (July 25, p. 156) records the fact that Mr K. Hirayama, of the Tokio Observatory, has published in the *Proceedings of the Imperial Academy of Japan* (7, No 5, 1931) an investigation of the effects of the impact of a star with a spherical nebula. Mr Hirayama, according to *Nature*, concludes that if the relative velocity were barely hyperbolic before impact, it might be reduced by the impact below the parabolic value, so that the consequent elliptic relative orbit, because of the frequent overtaking of one mass by the other, might be steadily reduced by repeated impacts, at each of which a part of the nebula would be detached and captured by the star, the final result being the formation of a planetary system.

There seems to be no reason why the argument should not equally apply if the encountering bodies were the sun and a star of less mass and much lower density. The establishment of such a theory as to encounters of stars with smaller stars or with spherical nebulae would do much to destroy the idea, sedulously fostered by Jeans, Jeffreys and others, that our system is unique. It may be possible to demonstrate that stars of mass and density so high as to be capable of rupturing by gravitational power alone masses comparable with the sun, are extremely rare or non-existent, but there is no evidence that bodies small enough to be ruptured by approach to or contact with such stars as the sun have not existed in the past, or do not still exist, so that practically all large stars may have had, or may yet have, each its own planet-feeder For the peace of the timid, it is to be hoped that nobody will suggest that the job in our system is not finished and that the remains of the sun's planet-feeder may be expected back to complete its disturbing mission

---

[8] "The Stars in Their Courses," 1931, p. 41.

OBITUARY

RUSSELL A. OAKLEY

Dr. Russell A Oakley, principal agronomist in charge of the Division of Forage Crops and Diseases of the Bureau of Plant Industry, U S Department of Agriculture, died at Monrovia, California, on August 6 He was born on a farm near Marysville, Kansas, on September 7, 1880, and graduated with a B S degree from the Kansas State Agricultural College in 1903 After a short period of graduate work in the University of Chicago, he accepted an appointment as scientific aid in the Department of Agriculture and served continuously in that department from July 16, 1903, until the time of his death. Because of the excellent service rendered during the war period as chairman of the Seed Stocks Committee and of his recognized ability as an agronomist, the Iowa State College upon the recommendation of President Pearson conferred upon him in 1920 the degree of Doctor of Science He was later elected fellow of the American Association for the Advancement of Science and of the American Society of Agronomy

Those who knew Dr Oakley best will remember him always as one who possessed to a remarkable degree the quality of making friends and as one endowed with almost superhuman courage and cheerfulness in long years of struggle with physical infirmities on account of arthritis His associates never ceased to marvel at the indomitable will which enabled him to go about his work day after day uncomplaining and efficient. This heroic attitude toward his afflictions was not the result of any religious belief or any tendency toward asceticism, it came rather as the result of his unconquerable spirit refusing to surrender and always "playing the game."

This brief description of the personality of Dr Oakley should add lustre to his achievements which are recounted in more detail in other journals It also accounts for his recognized success as an administrator The Department of Agriculture entrusted him with numerous assignments in the administrative field. From 1913 to 1926 he was in charge of the Office of Seed Distribution of the Bureau of Plant Industry, and in addition during the war period served as chairman of the Department Seed Stocks Committee, for several years he was assistant chairman of the Federal Horticultural Board and continued up to the time of his death as a member of the Advisory Federal Plant Quarantine Board Since 1926 he has been in charge of what is now the Division of Forage Crops and Diseases During much of the latter period he served as chairman of the Research Committee of the U S Golf Association Green Section He also performed with credit to himself and the department several special assignments of the Secretary of Agriculture

His research activities in agronomy were confined mostly to investigations with alfalfa and turf grasses He is co-author with the late C V. Piper of a book "Turf for Golf Courses," and with Dr Piper originated and edited for many years the U. S Golf Association *Green Section Bulletin* Dr Oakley is author of many department bulletins and articles in scientific journals. He leaves behind a splendid record of achievement

H. N Vinall

MEMORIALS

We learn from *Nature* that in view of the approaching centenary celebration of Clerk Maxwell, the Cambridge University Press announces a book of essays written to commemorate the event by Sir J J Thomson, Dr. Albert Einstein, Dr Max Planck, Sir Joseph Larmor, Sir James Jeans, Sir Ambrose Fleming, Dr W. Garnett, Sir Richard Glazebrook and Sir Oliver Lodge.

A committee, as reported in the London *Times*, has been formed to organize the appeal for a British national memorial to Sir Joseph Wilson Swan (1828–1914), who, apart from many lesser inventions, was the first to invent and introduce for practical purposes the electric incandescent lamp. Swan was also a pioneer in photography and the processes of photographic printing. The Institution of Electrical Engineers, of which Sir Joseph Swan was president in 1898, is presenting to the Borough of Sunderland a bronze tablet, designed by Mr R A. Ray, which will be erected in the entrance hall of the Sunderland Central Public Library, Museum and Art Gallery In addition, a committee representing the institute and Swan's native town is appealing for a sum of £5,000 with which to found National Swan Memorial Scholarships in electrical engineering science The fund will be administered by the Institution of Electrical Engineers, the interest being devoted to the payment of the scholarships

RECENT DEATHS

Dr Norman Bruce Carson, professor emeritus of surgery in the Washington University Medical School, died on August 9 at the age of eighty-six years

Dr John S Fulton, formerly director of the Maryland State Department of Health, died on August 12 He was seventy-two years old

Samuel Tobias Wagner, consulting engineer of the Reading Railway Company and professor of engineering at the Wagner Free Institute of Science, died on August 7 at the age of seventy years

Miss Sarah G Foote Sheldon, for over twenty-five years a volunteer full-time assistant to the late J. H. Paarmann, curator of the Davenport Academy of Sciences, now the Davenport Public Museum, died on July 2 at the age of about seventy-five years

Dr. Walter E Dixon, reader in pharmacology at the University of Cambridge, previously professor at King's College, University of London, fellow of the Royal Society since 1911, died at Cambridge on August 16

Professor Richard Wettstein, of the University of Vienna, director of the Vienna Botanical Gardens, died on August 10 at his estate, Triene, in the Tyrol He was sixty-seven years old

A **Reuter** message reports the death at Montreux of Professor Auguste Forel, who retired from the chair of psychiatry at the University of Zurich in 1897 He was the author of the "Social World of Ants"

SCIENTIFIC EVENTS

MEDIUMS FOR THE ISOLATION AND CULTIVATION OF BACTERIA IN THE FILTERABLE STATE

The Northwestern University Medical School has issued a bulletin by Dr Arthur I Kendall, professor of research bacteriology, giving full details for the preparation of K medium for the isolation and cultivation of bacteria in the filterable state

In the James A Patten lecture, given on July 22 and printed in the issue of Science for August 7, Dr Kendall made the first announcement of the discovery of a new method for the isolation of bacteria which hitherto have remained invisible This was the development of a culture medium, which will change bacteria from invisible to visible form

In the new bulletin issued on August 9, Dr Kendall describes in detail how the K mediums are made from the tissue of the animal or human body Intestine has been used chiefly for this purpose, although Dr Kendall states that brain, liver, kidney, spleen and heart have been used "Hog intestine," he writes, "has been distinctly more suitable than rabbit intestine and rabbit intestine has appeared to be more favorable than dog intestine Human intestine which was not available when early studies were made is under investigation at present"

After full details of the preparation of the mediums and commenting upon aspects of their use, Dr Kendall gives the following conclusions

> The K mediums, protein rich and peptone poor, have afforded a direct method of approach to the purview of three highly important aspects of bacteriology which are mutually related and dependent
>
> *First* (theoretical), it appears to be a biological fact that many bacteria can, and do, exist in two states, filterable and non filterable
>
> *Second* (clinical), bacteria may be isolated from the blood stream of patients suffering from diseases that have hitherto proved difficult or refractory to cultivation
>
> *Third* (intrinsic), homologous bacteria may be cultivated both from bacteriophage and from Besredka antivirus
>
> From the biological point of view, this demonstration of the filterable and non filterable states of microbic existence not only opens new fields for exploration, it also offers reasonable explanations for many hitherto suspected, but unconfirmed phenomena of microbic activity Thus, bacteria growing in K medium from stock cultures, thereby undergoing change from non filterable to the filterable state, not only are separable by filtration into those not cultivable in ordinary mediums (the filterable forms) but also tend to differentiate rather readily into "smooth" and "rough" types (the non-filterable forms), which may be separated by plating directly upon agar mediums Also, the filterable forms, recultivated upon agar, often may be separated into "smooth" and "rough" types
>
> Chemical studies already under way suggest that the respective activities of these filterable and non-filterable forms are quantitatively and possibly qualitatively unlike. It may be stated also that the first editions of non-filterable forms obtained upon agar are, or may be, materially less reactive than the fully acclimatized, non-filterable forms gained by repeated transfer.
>
> Finally, perhaps the most transpicuous argument at

the present time against the plea of "leaky filters" as being an explanation for the existence of the filterable state of bacteria, is to be found in the oft repeated cultivation of homologous bacteria from various kinds of bacteriophage. Bacteriophage has been a subject of investigation in innumerable workshops. Two facts are quite universally agreed upon. First, that phage in an active state is filterable through the finest stone filters. Second, attempts to cultivate homologous bacteria from phage filtrates have been almost axiomatically unsuccessful. It is, however, a comparatively simple matter to obtain growth of the homologous "phaged" microbe in the filterable state in K medium. From this growth in K medium, direct cultivation at the proper time upon agar will yield colonies of re-phagable organisms.

THE LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

According to the regular London correspondent of the *Journal* of the American Medical Association, the London School of Tropical Medicine, founded in 1899, has undergone great development in recent years, largely in consequence of the munificent gift of $10,000,000 from the trustees of the Rockefeller Foundation to enable the University of London to establish a center of postgraduate teaching and research in the science and art of preventive medicine. The idea that preventive medicine should embrace not this country alone but the whole world led to the incorporation of tropical medicine in the scheme. Hence the palatial buildings which were opened in 1929 by the Prince of Wales are called the London School of Hygiene and Tropical Medicine. The school is probably the most complete institution of the kind in the world. The staff is organized in six main divisions, public health, biochemistry, bacteriology, medical zoology, epidemiology and vital statistics, tropical medicine. The students form three main groups. A number varying between 70 and 100 come for a course of six months in tropical medicine and hygiene. Most of these are already in or desire to enter a public medical service in the British Empire or foreign countries. In a paper read before the Royal Society of Arts, Major Greenwood, F.R.S., professor of epidemiology and vital statistics, states that the course of instruction, partly clinical, partly laboratory training, makes considerable demands on their energy because much ground has to be covered in the time. The next largest group consists of students seeking to enter public health service and intending to sit for the diploma examination in public health of the University of London. This course is longer and takes a whole year, and it is possible to present the different aspects of a problem of disease more completely—the chemical, bacteriologic, parasitologic, epidemiologic and administrative sides one after another. Thus a sound knowledge of, say, the prevention of plague is obtained from various specialists. The third group consists of students specializing in one branch, such as bacteriology or epidemiology. It is said to include some of the best students, many of whom are foreigners. The division of epidemiology has already had students from thirteen countries.

THE RETURN OF "THE DISCOVERY"

The London *Times* reports that *The Discovery*, Captain Scott's old ship, returned to London on August 1 and berthed at the East India Docks after two years in the Antarctic. Sir Douglas Mawson, the leader of the expedition, was not on board, having left the ship in Australia.

Captain K. N. Mackenzie, who is a native of Oban, said that a fine film of the voyage had been made, including many interesting scenes of penguins and icebergs. On arrival at Sir Douglas Mawson's 1910 camp in Cornwath Bay they found a tin of tobacco which had been lying there for over 20 years. It was in perfect condition, and with much amusement they watched Sir Douglas enjoy his first puff of this old mixture. The expedition had a number of dangerous experiences with icebergs in discovering seven hitherto uncharted regions. These new regions are Princess Elizabeth Land, MacRobertson Land, Bansarctic Land, Sabrina Land, Knox Land, Kemp Land and Enderby Land. Altogether, the expedition charted 1,000 miles of new coast line, which they flagged and claimed for Britain. One third of the whole of the Antarctic Continent was circumnavigated and 4,800 miles of Arctic water plied. The expedition collected data which has been left at Adelaide University, from which it is expected that several scientific discoveries of importance will be made. The slump in the whaling industry had given the whales a much-needed chance to survive, and the expedition discovered two new whaling grounds of first-rate importance.

Navigating Officer W. R. Colbeck, speaking of the blizzards experienced in the Antarctic, said that on one occasion the expedition encountered a hurricane off Adelie Land. The engines could not face it, and as a heavy sea was running they were drifting on to the edge of an ice pack. The sides of the vessel were badly battered. Later, the vessel was jammed in an ice pack for several days. The expedition went as far south as 68½ degrees, when they came to land and could go no further. Some special broadcast programs were sent out from Sydney on a short-wave length and were enjoyed very much. The expedition did a great deal of oceanographic work as a result of which 20 tons of specimens were obtained.

ADDITIONS TO THE HERBARIUM OF THE U S NATIONAL MUSEUM

THE National Museum, with more than 1,500,000 specimens of plants from all over the world, has recently acquired quantities of valuable specimens from South America, according to information recently given to a representative of the *U S Daily*

Among these plants, it is expected, will be found many novelties About 600 specimens have been brought to the museum by Mr W A Archer, who has been collecting privately many varieties in the Choco region of northwestern Colombia

Already supplied with a fine Asiatic collection and a good European collection, acquisitions from South America in the past year contributed by two explorers augment the specimens from this region Many of these plants may prove to have scientific and economic value as the use to which the Indians put them medicinally suggests fertile fields for scientific analysis However, the museum merely collects, identifies, classifies, and names the specimens, without attempting to experiment with them for scientific possibilities

The National Geographic Society recently presented a large number of plants collected by E G Holt in an expedition to the Upper Orinoco For several months his expedition was attached to the Brazilian-Venezuelan Boundary Commission, and from this heretofore inaccessible border region the greater part of the collection was taken

The last trip conducted by the Smithsonian resulted in collecting 9,200 plants Mr Archer has contributed about 3,000 to the museum, representing private expeditions by him into Colombia

The South American collection is growing rapidly. Prior to 1920 there were only two or three collections from this area. Since, the expeditions have been conducted in cooperation with Harvard University and the New York Botanical Garden Three expeditions have been made into Colombia, two to British Guiana, and two to Ecuador These journeys were made by the museum as part of a cooperative plan of collecting

SCIENTIFIC NOTES AND NEWS

THE Baly Medal of the Royal College of Physicians of London, conferred every alternate year on the person who shall be deemed to have most distinguished himself in the science of physiology during the two years immediately preceding, has been awarded to Professor W B Cannon, of the Harvard Medical School

THE honorary degree of D Litt will be conferred in December by the University of Liverpool on Dr James Rowland Angell, president of Yale University, formerly professor of psychology in the University of Chicago

PROFESSOR KASIMIR FAJANS, professor of physical chemistry and head of the chemical laboratory at Munich, has been made an honorary member of the Royal Institution of Great Britain, a distinction which has been conferred on several other German scientific men including Professor Einstein, Professor Ostwald, the chemist, and Professor Laue, the physicist Professor Fajans gave the George Fisher Baker lectures at Cornell University in 1930

THE Silver Leibnitz Medal of the Prussian Academy of Sciences has been awarded to Dr Karl Scheel, professor of thermodynamics at Berlin, and to Dr Agnes Bluhm, of the Kaiser Wilhelm Institute for biology.

THE *Journal* of the American Medical Association reports that Dr Edward O. Otis, of Exeter, New Hampshire, formerly of Boston, was recently honored by more than a hundred physicians, nurses and health workers at a special meeting at the headquarters of the Boston Tuberculosis Association to commemorate the fiftieth anniversary of his service in that field. Dr Otis, who is an honorary president of the Massachusetts Tuberculosis League and a former president of the National Tuberculosis Association, was presented with a purse of gold on behalf of the league Speakers on this occasion included Drs. Frederick T Lord, George H. Bigelow, state commissioner of health, and John B Hawes II. Dr. Otis, who is eighty-three years old, is also professor emeritus of pulmonary diseases and climatology at Tufts College Medical School

DR. ALBERT H. MILLER, associate editor of the *Rhode Island Medical Journal*, Providence, was recently awarded the Fiske Fund Premium for his essay entitled "Anesthetics—Their Relative Values and Dangers" Established ninety-six years ago by the will of Dr Caleb Fiske, one of the early presidents of the Rhode Island Medical Society, the fund provides for an award to the author of the best essay submitted each year and for the subsequent publication of the essay

LORD BALFOUR, of Burleigh, has been elected president of the British Royal Sanitary Institute, in succession to the late Duke of Northumberland.

MR. GILBERT T RUDE has been appointed chief of the Division of Marine Operation of the U S Coast and Geodetic Survey

DR KENNETH M WATSON, formerly professor of chemical engineering at the University of Wisconsin, has joined the research and development staff of Universal Oil Products Co Dr Watson's headquarters will be at the Universal's Riverside Laboratories, Chicago

THE Oregon State Board of Higher Education has appointed Dr A B Cordley, who has served the state for thirty-six years, for the past twenty-three years as dean of the School of Agriculture of Oregon State College, dean emeritus of the school During Dr Cordley's service as entomologist and plant pathologist of the experiment station, according to the resolutions adopted by the board, he made three outstanding discoveries that have been the means of adding great productive wealth to Oregon, namely, (1) his discovery of the life-history of the codling moth under Oregon conditions, and of a successful method of control, (2) his discovery of the cause of apple-tree anthracnose and of a control method, (3) his invention and development of the method of stock solution of lime-sulfur spray for control of apple scab

THE Maryland State Department of Health has selected Anne Arundel County as the site for an experimental health service which, according to the state health director, Dr Robert H Riley, may lead to the establishment of a model full-time health department Dr John H Janney, Jr, of the Rockefeller Foundation, has been named director of the new unit The cost of the experimental department will be $20,000 annually, which is about twice the cost of the average county health department It will be borne by an appropriation of $5,000 by the county commissioners, $7,000 advanced by the State, and the remaining $8,000 contributed by the Rockefeller Foundation and the Johns Hopkins School of Hygiene

DR WILLIAM W JAMESON, professor of public health in the London School of Hygiene and Tropical Medicine, has been appointed dean of the school, succeeding the late Sir Andrew Balfour

MR E C TITCHMARSH, of Balliol College, Oxford, has been elected to the Savilian professorship of geometry, vacated by the resignation of Professor G H Hardy

DR. A F JOSEPH has retired from the deputy directorship of the Imperial Bureau of Soil Science, a post which he has held since the inception of the bureau in May, 1929.

THE Ramsay Memorial Fellowship trustees, London, have made the following awards of fellowships for 1931–32 Mr B K Blount, a fellowship of £300, tenable for two years, at the University of Oxford, Mr Ragnar Ericson, civil engineer, a Swedish fellowship of £300, tenable for two years, at the Imperial College, London, Dr George Karagunis, a Greek fellowship of £400, tenable for one year, at University College, London, Dr. J Lens, a Netherland fellowship of £300, tenable for two years, at University College, London, Dr Y Urushibara, a Japanese fellowship of £400, tenable for two years, at University College, London The trustees have renewed the following fellowships Mr W R Angus, British fellow, University College, London, Dr James Bell, Glasgow fellow, University College, London

BY an order of the Committee of the British Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, the Right Honorable Lord Dawson of Penn, president of the Royal College of Physicians, and extra-physician to the London Hospital, and Dr Edward Mellanby, F R S, professor of pharmacology in the University of Sheffield, are appointed members of the Medical Research Council in succession to Professor T R Elliott, F R S, and Professor J B Leathes, F R S, who retire in rotation on September 30

DR NELSON W TAYLOR, of the University of Minnesota, is conducting x-ray research during the summer at the Utah Engineering Experiment Station, Salt Lake City, in connection with the work on mineral physics which is being done there

PROFESSOR R B THOMSON, of the department of botany of the University of Toronto, has resumed his work after a year's leave of absence spent mostly in the British West Indies

DR. DARWIN O LYON writes from Tripoli, expressing regret at sensational items that have appeared in the daily press concerning his work Under the auspices of the Royal Meteorological Observatory of Libyia, he is at present making experiments with sounding balloons and rockets in order to get data on the temperature, density and composition of the atmosphere at great heights

LORD MOYNIHAN, president of the Royal College of Surgeons of England, sailed for South America on July 24, to take part in the forthcoming medical conference at Buenos Ayres

LECTURES recently given before the Scripps Institution of Oceanography at La Jolla, California, include one by Dr F S Brackett, chief of the new division of radiation and organisms of the Smithsonian Institution, on "The Study of the Effect of Radiation on Plants" and one by W. P Kelley, of the division of agricultural chemistry of the Citrus Experiment Station at Riverside, California, on "Base Exchange in Soils."

THE following appointments of lecturers for 1932 have been made by the Royal College of Physicians· Sir George Newman, Harveian orator, Dr. Dugald Baird, Bradshaw lecturer, Dr Harriette Chick, Oliver-Sharpey lecturer, and Dr L P Jacks, Lloyd-Roberts lecturer

PROFESSOR WILLIAM DOBINSON HALLIBURTON, emeritus professor of physiology, King's College, London, who died on May 21, provides in his will, on the death of his wife, £10,000 to the University of London, King's College, for endowment, or towards the salary of a professor in the subject of physiology or the sciences relating thereto

THE *British Medical Journal* reports that the Kerckhoff Institute for the study of affections of the heart, built from a donation of a million dollars by Mrs Louise E Kerckhoff, of Los Angeles, as a memorial to her husband, has been opened at Bad Nauheim. The building, in classic style, consists of two main cubicle structures with a connecting wing It contains an auditorium seating six hundred persons and intended for congresses, and a smaller lecture room A medical library and a museum with representations of methods of treating circulatory disturbances, physical diagnosis and therapy, balneological collections, etc, are at the disposal of investigators. The institute will conduct special continuation courses open also to foreign physicians It is divided into five main departments one for patients sent to Bad Nauheim under the German social insurance system, a statistical department devoted to research into the causes of cardiac diseases, a department for educating the public as to causes and treatment of such diseases, another for their study and treatment, and a department covering treatment by physical methods, especially baths Professor Groedel is at the head of the institute, for the maintenance of which Mrs. Kerckhoff has provided a fund of one million marks

ACCORDING to *Industrial and Engineering Chemistry* progress in the plans for the erection of a headquarters building for American pharmacy, near the National Academy of Sciences in Washington, D C, was reported at the seventy-ninth annual convention of the American Pharmaceutical Association held in Miami, Fla., the latter part of July. A total of $501,904.82 has been collected from pharmacists and the various branches of the drug trade, and over $315,000.00 more has been pledged to the undertaking Plans have been drawn and approved, and actual construction is being held up only until the Commission of Fine Arts of the Federal Government completes its own plans for the development of that part of the District of Columbia where the site of the proposed building is located. An effort will be made to endow the building to the extent of one million dollars It is planned to provide a permanent repository for historical material bearing on the profession of pharmacy, to supply research facilities as well as a pharmaceutical library second to none in the country, and office facilities for the various activities of the American Pharmaceutical Association. It is believed that construction of the building will be completed by the close of 1932

EXCAVATION for the new building of the Eye Institute of Columbia University, which it is estimated will cost $1,100,000, has been started It is expected that the building will be finished in about a year The Eye Institute, which will be a part of the Columbia Medical Center, is to be an eight-story building at Fort Washington Avenue and 165th Street and is architecturally in harmony with the group occupying the area from 155th to 168th Streets and from Fort Washington Avenue to Broadway The basement will be used for storage, service and x-ray rooms The first floor will be used for administrative offices and for receiving patients The next five floors will be devoted to bedrooms and wards The operating and lecture rooms will be on the seventh floor and the laboratory will be on the eighth floor Mr James Gamble Rogers is the architect of the building

The British Medical Journal reports that the American Medical Association of Vienna, which was founded in 1904, and is a society of English-speaking medical practitioners, publishes a useful "blue book" every two years The new edition of this, which has recently appeared, contains a comprehensive list of the study courses available in Vienna throughout the year for those who have little or no knowledge of German The society has arranged with prominent physicians and specialists of the University of Vienna to conduct special courses and provide private tuition as may be required, and on reasonable terms. About 4,000 medical practitioners have become registered members of the association since January, 1923, a quarter of these joined it last year, an indication of the rapid growth which is going on. Any medical practitioner arriving in Vienna as a total stranger, even though unacquainted with the German language, can, through its agency, obtain specialist instruction in any subject for periods of any length. *Ars Medici*, the official monthly bulletin of the American Medical Association of Vienna, contains reviews and abstracts of the latest publications in foreign medical literature, special departments being devoted to German and Austrian medical research, a special section deals with the scientific and social activities in Vienna. Inquiries may be addressed to the secretary of the American Medical Association of Vienna at its headquarters, Alserstrasse 9, Vienna VIII.

THE London *Times* reports that at a general meeting of the British Society for the Preservation of the Fauna of the Empire, held on August 3 at the offices of the Zoological Society of London, with Mr. Speden Lewis presiding, the report of the executive committee was presented. It stated that since the last general meeting efforts had been begun to investigate conditions in Labrador, to ascertain whether one or more areas could be set aside as sanctuaries. The question of dispatching a mission of inquiry to West Africa had been proceeded with. The most suitable time for the dispatch of the mission would be about the end of November. For reasons of economy the Game Department of Nyasaland had been abolished. This was disappointing, for its constitution was in a great measure due to the representations of the society, and owing to the excellent warden appointed it had been a great success. Representations were being made in the proper quarter. They were also being made about the Indian rhinoceros, as information had been received that poaching in Assam had been intensified of late, and there was little doubt that unless it could be checked the vanishing point would soon be reached.

A RECENT survey by the Pennsylvania Forest Research Institute shows that the American chestnut, which seemed marked for destruction by a fungus blight which killed nearly every adult tree in the Eastern States some years ago, is recovering from the devastating attack of disease. New shoots from the roots of the trees that were killed by the fungus have been growing rapidly with every evidence of health and strength and the Pennsylvania Institute reports that a fairly good sized crop of chestnuts may be gathered this year from the young trees. The blight from which chestnut trees in the eastern United States have been suffering began in 1904, when it was first discovered in a park in Brooklyn. It rapidly spread until all the states from Maine to West Virginia were affected in varying degrees. In parts of the country practically all the native chestnut trees were destroyed.

AT the recent international jubilee meeting in London of the Society of Chemical Industry a plan was arranged for the cooperation between manufacturers of Great Britain, France and Germany. French and German scientists and industrialists visited the exhibition of British Chemical Plant, and it has been provisionally agreed that future exhibitions of this nature in the three countries shall be organized and advertised in close collaboration. Each country will take its turn triennially. France will hold her next exhibition in 1932, Germany will follow with "Achema" in 1933, and the exhibition will again be held in Great Britain in 1934. The representative organization in each country dealing with the manufacture of chemical plant will be responsible for organizing parties to visit the exhibitions held in the other countries.

DISCUSSION

THE SUMMER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE IN 1933

THE Chicago Centennial is an international exposition under national auspices, but it is more than this, it is an intellectual occasion. Even if the exposition were devoted exclusively to economic and commercial exhibits it would be full of interest to all students of social science, for, after all, economics is really only the objective side of the great science of *how men live together*. The fact is, however, that the pure sciences have been given a fundamental position in the plan of the exposition, the principal theme of the undertaking being the dependence of industry upon the basic sciences.

Shortly after the American Association for the Advancement of Science decided to hold a summer meeting at Chicago in 1933, the trustees of the exposition decided to cooperate by providing for the invitation of a considerable number of men of science from foreign countries as guests of the meeting. Accordingly the Council of the American Association for the Advancement of Science was asked to suggest the names and proper distribution of these guests. At the Cleveland meeting, 1930, the following committee was charged with this duty: J. McK. Cattell (chairman), W. B. Cannon, H. Crew, B. E. Livingston, R. A. Millikan, T. H. Morgan, F. R. Moulton, W. A. Noyes. Meeting at the Cosmos Club in Washington, D. C., on April 27 and 28, the committee allotted a definite number of guests averaging about five to each of the fifteen sections of the American Association for the Advancement of Science. Suggestions as to individual scholars, men of marked achievement, leaders of thought, were next sought from the various divisions of the National Research Council, as well as from the secretaries of the different sections of the American Association for the Advancement of Science and of certain societies of specialists The response to these requests has been generous and, for the most part, prompt

It is hoped that guests accepting the invitation will appear on the program of the association's meeting and will also be available for one or more public lectures in various scientific centers For a number of years past the program of the American Association for the Advancement of Science has been a highly important one, even when limited entirely to the productive scholarship of America The foregoing plan is intended to enrich the regular program and is felt to be in full harmony with the international character of the exposition

No attempt will be made to give, in a single week, a cross-section of human knowledge but it is believed that a bird's-eye view of the main lines of present-day research will be presented and will render the 1933 meeting a memorable scientific occasion The aim is to establish personal contact between an intelligent audience and the leaders in science The Century of Progress is the name under which this exposition is incorporated, but there is here no implication that it is a backward looking institution The whole purpose is, indeed, to point the way to another coming Century of Progress, to demonstrate the unity and importance of science Every effort will be made to eliminate from this meeting the turmoil and bustle of a world's fair by the selection of appropriate meeting places But if, in these efforts, the local management is not in every way successful there will be compensations, illuminations of mind and matter, and foregatherings, which will leave the balance on the right side

By action of the council of the American Association for the Advancement of Science at its recent meeting in Los Angeles, the exact date of the Chicago meeting was fixed as the last full week in June, 1933

John Stephen Sewell

Director of Exhibits,
Chicago Centennial Exhibition

THE MARINE LABORATORY OF THE UNIVERSITY OF SYDNEY, AUSTRALIA

I have just received from Professor W J Dakin, of the department of zoology, University of Sydney, New South Wales, Australia, a letter in which he informs me that, notwithstanding the great financial stringency in Australia he has succeeded in procuring funds for the establishment of a small temporary marine laboratory and the acquisition of an auxiliary yacht of 13 tons. Both the laboratory and the yacht belong to the department of zoology of the University of Sydney A program of investigations without aid from the state is being carried out, although serious financial difficulties beset the University of Sydney At present particular attention is being devoted to the plankton and certain hydrographic conditions to a distance of about five miles off shore east of Sydney Already plankton catches have been taken regularly for eighteen months Professor Dakin himself has been conducting experiments on the osmotic pressure of the blood of certain marine organisms apart from investigations that he has already made on "The osmotic concentration of the blood of *Callorhynchus milii* and *Epiceratodus* (*Neoceratodus*) *forsteri*, and the significance of the physico-chemical condition of the blood in regard to the systematic position of the Holocephali and the Dipnoi "[1]

Professor Dakin writes that his laboratory is very badly off for literature and that he is unable to raise more money to face the adverse exchange rates He has asked help in obtaining literature, especially on the physical and chemical methods of oceanography and on plankton It has occurred to me that by publishing this note in Science assistance for Professor Dakin's struggling laboratory might be procured He says "We are doing our utmost with private funds and often risking life too by working from inefficient boats on a most unruly because unprotected sea" Will those who are willing to send literature please address it as follows Professor W J Dakin, Department of Zoology, University of Sydney, New South Wales, Australia Any help that may be extended will be very greatly appreciated

T Wayland Vaughan

Scripps Institution of Oceanography

DEVELOPING NEW VARIETIES OF HOPS

Last fall work was initiated to develop new varieties of hops Because of an attack of downy mildew, *Pseudoperonospora humuli* (Miy et tak) Wils, it was desired to obtain new varieties which were not only resistant to this disease, but also superior in yield and quality The variety Fuggles has been reported as resistant to this disease This variety, however, under most Oregon conditions, is considered low in yielding ability and of a quality that is desired only by a certain trade

Naturally fertilized seeds of this crop were collected in the growers' yards Preliminary trials showed that the seed was dormant and would not grow under ordinary germinating conditions The seed, therefore, was chilled for about ten days at freezing temperatures and then scarified by rubbing on coarse emery paper. This seed was planted in the greenhouse on October 9 in flats and the seedlings were transplanted to a bed after they had made a growth of about 12 inches Artificial lights (three 500-watt Mazda lamps for 100 plants) were turned on from 5 to 12 P M each night Plants 20 feet in length were developed by March 29, and two of the plants came into burr (blossom) at this date A growth of 12 inches was recorded in one day This development of a hop plant from seed to blossom in less than six months' time indicates the possibilities of rapid development of new varieties Professor E S Salmon, in England, stated that the "work of raising new varieties of hops is an arduous and expensive one and is necessarily very slow, since the seedling plants do not bear a crop until the third year, and can not be judged for character such as aroma, richness in resins, and cropping powers until the fifth year, at the earliest"

---

[1] Zool Soc London, *Proc*, pt 1, pp 11–16, April 14, 1931

The use of chilling and scarification of seed, the greenhouse and the lights are of great assistance in speeding up a program of breeding with a crop of this type The striking variability of seedlings indicates a great difference in the value of the different plants Of course, it will take additional time to test out not only their disease resistance, but also their yielding ability and quality Also, some time will be required to increase their vegetative parts for planting stock

This procedure not only speeds up the breeding program, but also gives available plants for test n in the spring when inoculum of the downy mildew disease, which is a true parasite, is plentiful

E. N Bressman
Oregon State Agricultural College

POLYEMBRYONY IN RED SPRUCE

In the course of a germination test of red spruce *Picea rubra* (Link) collected in eastern Maine in the fall of 1930, two well-formed radicles, each about 2 cm long, were observed protruding from the same seed coat Unfortunately, upon removing the sprouted seed the root tips were damaged, so that it was impossible to grow the seedlings Upon dissection two sets of well-formed cotyledons were disclosed Both seedlings appeared to be of equal vigor, so that it seems probable that two normal seedlings would have developed, had they been undisturbed Similar phenomena have been reported by Jacobs[1] in sugar pine, *Pinus lambertiana* (Doug), in 1 per cent of all seeds tested by him, and recently by Woodworth[2] in *Alnus rugosa* (Du Roi) Spreng, but the writers are unaware that polyembryonism has been recorded in red spruce During nearly 300 tests of this species, aggregating over 30,000 seed, this has been the only case observed.

Henry I Baldwin
Warren E Percival
Berlin, New Hampshire

ABBREVIATIONS FOR SCIENTIFIC AND ENGINEERING TERMS

Nearly two hundred years ago an Englishman determined the value of π to 707 decimal places One state legislature is said to have "standardized" the value of π as 3 Between these impracticable extremes lies the value which has served, and will continue to serve, the purposes of science

As a matter of convenience, abbreviations have been established for many words which are in frequent use or which are cumbersome by reason of length Many of these abbreviations, though not logically derived from the English words which they now represent, have been sanctioned by custom, and the period at the end is the generally accepted sign of an abbreviation A chemical symbol is quite generally written without the period, and thus in present usage there is a distinction between C (for carbon) and C (if that form be used for centigrade)

The list of "Abbreviations for Scientific and Engineering Terms" prepared by a sectional committee of the American Standards Association proposes to abolish the period, to change many of the time-honored forms of abbreviation, and in many instances to "standardize" two forms of abbreviation for the same word

Elimination of the period is proposed "in the interests of economy and the reduction of waste" It is difficult to see how this will be realized No economy of time is indicated in printing and proofreading where the printer is expected, for example, to set "cu m" (for cubic meter) and (in the absence of periods which determine the spacing) to decide whether cum or cu m is the proper form

Though the American Association for the Advancement of Science is given as one of the organizations sponsoring this proposed list of abbreviations, the writer has consulted a number of association members without finding one who knew of the list, or who favors it in its present form.

If the list is to be sanctioned by the association, many members who are careful in their use of English will no doubt be interested in the proposed forms. The list appeared in the "ASA Bulletin" of July, 1930, and in a publication dated January, 1931, designated as "A. S A Z10i-1931."

The list is not a very long one, but its adoption promises a long period of confusion. Somewhere between the complete word and the arbitrary and ambiguous form of abbreviation, there is a well-established tradition which should not be entirely ignored if wide-spread use rather than mere official adoption is to be achieved.

---

[1] Allen W Jacobs, "Polyembryonism in Sugar Pine," *Jour. For.*, 22 573–574, 1924.

[2] Robert H Woodworth, "Parthenogenesis and Polyembryony in *Alnus rugosa* (Du Roi) Spreng," Science, n. s., 70: 192–193, 1929.

E. H. McClelland
Carnegie Library of Pittsburgh

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE MICROPHONE AMPLIFIER

In the transmitter of the ordinary telephone, the vibrations of the diaphragm produce varying pressures upon carbon granules or a carbon button. The electrical resistance of the carbon varies with the pressure so that an electrical current may be made to vary in accordance with the impressed sound waves. This current, although controlled by the sound vibrations, has much more energy. Hence, the carbon button acts as an amplifier for sound vibrations.

It is, therefore, possible to make use of the carbon transmitter as an amplifier for wireless signals. The circuit is shown in Fig. 1. The output from an ordinary detector valve AB is passed through the coils of a wireless receiving telephone. The type used in this circuit is a Brown telephone. The diaphragm of the Brown telephone is set in vibration by a little metallic reed which is itself actuated by the rectified current from the detector tube. The diaphragm of the Brown receiver is removed and a short light metallic rod is connected from the reed C to the middle of the diaphragm D of a telephone transmitter. Then when the reed vibrates in unison with the incoming signals the diaphragm of the transmitter D presses against the carbon button E. The current supplied from the six-volt storage battery F varies with this pressure. Accordingly a variable current passes through the primary of the audio transformer G. This causes a current in the secondary which actuates the loud speaker H. The audio transformer is inserted to prevent the direct current generated by the battery F from passing through the coils of the loud speaker.

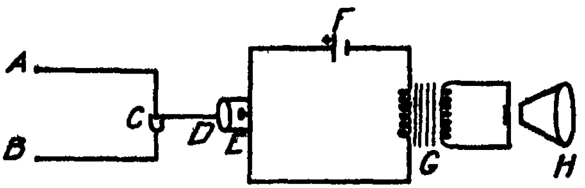


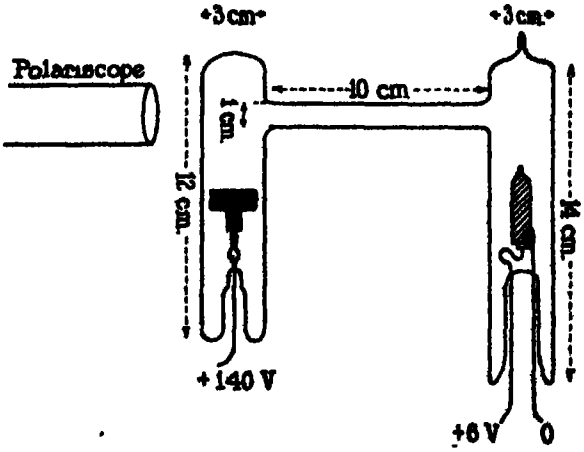
Fig. 1

This arrangement gives plenty of amplification, but the quality is rather poor. The device is not very sensitive, as the carbon button will not respond to weak vibrations.

R. C. Colwell
L. Fullmer
Department of Physics,
West Virginia University

THE USE OF A HOT CATHODE HELIUM LAMP AS A SOURCE OF MONOCHROMATIC LIGHT FOR THE POLARISCOPE

A continuous spectrum in conjunction with suitable prism and diaphragms is not well adapted for precise measurement of rotatory power. The mercury arc unfortunately gives only two lines suitable for polarimetric purposes ($\lambda = 5460.7$ Å and $\lambda = 4358.3$ Å). The two yellow lines, 5790.7 Å and 5769.7 Å, are too near to one another to permit an easy separation, especially as a great intensity is needed for measurements of rotatory power. The helium spectrum shows two intense lines, a yellow one ($\lambda = 5875.6$ Å) and a red one ($\lambda = 6678.1$ Å). The yellow line permits measurements of great accuracy and can be used to great advantage in place of the inconvenient mercury yellow lines. Furthermore, it presents a second advantage in being situated very near the sodium doublet for which the rotations of the majority of organic compounds have been determined.



Hot cathode helium lamp

Except for the red line furnished by the Cd arc, which is difficult to operate for routine work, there is no red light readily available which is intense and pure enough for the purpose specified. The helium red line is located very far towards the red and is ideal for measurements in that part of the spectrum.

With the lamp described above, the intensity of this line was such as to permit a reading within ± 0.015° with a half shadow angle of 4°. Using a photographic process the angle could be read within ± 0.003° (exposure 60 seconds, half shadow angle 4°).

Measurements with the yellow line 5875.6Å were consistent within ± 0.002°.

The lamp used, which is reproduced in the above diagram, was an all-quartz hot cathode helium lamp built by the General Electric Vapor Lamp Company, Hoboken, N. J. The arc was operated under 160 volts and carried 5 amperes.

ALEXANDRE ROTHEN

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
NEW YORK

SPECIAL ARTICLES

ACTION CURRENTS IN THE AUDITORY TRACTS OF THE MIDBRAIN OF THE CAT

IN the course of an investigation of action currents in the central nervous system of the cat by means of an amplifier in connection with ear phones or a string galvanometer, responses were obtained from the auditory tracts of the midbrain. The intensity, timbre and pitch (up to at least 1,000 per sec.) of the sounds applied to the ears of the cat were reproduced with considerable accuracy in the ear phones. The observations of Wever and Bray[1] on the auditory nerve were repeated and their results confirmed. Adrian's observations,[2] which led him to suggest that the effect in the nerve is due to a diffuse electrical spread from the cochlea, have also been confirmed, but with the following qualification: (1) The responses are much greater in the auditory pathways than in the surrounding tissue. (2) There appears to be a decrease in the size of the responses upon the local application of narcotics.

We believe that the effect in the brain stem represents at least two elements: primarily, action currents in the particular auditory tract to which the electrode is applied, and secondarily, electrical spread from more distant parts of the auditory mechanism.

Our method allows stimulation of either or both ears. A stethoscope is fitted to the decerebrate cat. Its bell receives taps at constant rate and intensity. Voice or other sounds may be delivered through a funnel in place of the stethoscope bell. The sound may be localized to one ear or the other by clamping the appropriate arm of the stethoscope. A diffuse silver electrode is placed subcutaneously on the muscles of the skull and a differentiated electrode consisting of a fine silver needle, insulated except for the very tip, is pushed down the brain stem caudally at right angles to the planes of decerebration.

Sharpness of localization is characteristic of responses in the brain stem. Using the string galvanometer with one stage of amplification the responses are obtained *only* from certain points. A movement of the electrode of one millimeter or less suffices to pass through a maximum and usually to loose the response. With a more sensitive amplifier and ear phones this point represents a very sharp maximum, many times louder than the responses from neighboring points. These active points have been shown by subsequent gross section to lie invariably upon the auditory pathways, including the trapezoid body, acoustic striae, and lateral lemnisci up to the inferior colliculi. Numerous other regions explored, not on the pathways, have never given any response with the less sensitive apparatus.

When electrodes are placed upon crossed tracts, such as the lateral lemniscus, the responses are chiefly contralateral, *i.e.*, the electrode in the left midbrain is much more sensitive to stimuli applied to the right ear than to those applied to the left ear. This contralateral relationship agrees well with the known anatomy of the auditory pathways.

When the cat dies in the course of an experiment the responses from the brain stem are lost as soon at the heart stops beating, and sometimes a few minutes before. The responses from the acoustic nerve persist after those from the brain stem are no longer detectable, and sometimes for several minutes after the heart has stopped.

Narcotization of parts of the brain stem by injecting 5 per cent. or 10 per cent. novocaine in Ringer's solution near the electrode obliterates responses on the string. The responses return after one to three hours. If the novocaine is injected on one side of the brain stem between the electrode and acoustic nerve, responses from that ear disappear, while those from the other ear persist.

Comparison of responses from the acoustic nerve with those from the brain stem shows that those from active points in the brain stem are usually slightly greater than those from the nerve. This is true even if the electrode pierces the sheath of the nerve, thereby yielding greater responses than if on its surface.

---

[1] E. G. Wever and Charles W. Bray, SCIENCE, 71, 215, 1930.

[2] E. D. Adrian, *J. Physiol.*, 71, 4: 1931.

Words are always reproduced more clearly and intelligibly from the nerve Those from the brain stem, while often intelligible, are always somewhat blurred. There is some doubt as to whether the upper limit of pitch is as high for the brain stem as for the nerve

We believe that the above evidence indicates that we are dealing with true action currents in the auditory pathways It demonstrates the possibility of direct study of the activity of individual tracts within the central nervous system, by such methods as have been employed for peripheral nerves and the cerebral cortex

H Davis
L J Saul

Departments of Physiology
and of Psychiatry,
Harvard Medical School

THE EFFECT OF HYPOPHYSECTOMY ON GESTATION IN THE RAT[1]

Experimental work on the functions of the pituitary gland has dealt largely with the effects of extirpation of this gland on growth and on the development of the reproductive organs, and, with the exception of the early work of Aschner on pregnant dogs, no further studies seem to have been carried out on the effects of hypophysectomy on the maintenance of pregnancy in mammals It seemed of interest, therefore, to see what effects, if any, removal of this gland would have upon the course of gestation in the rat

A total of 43 pregnant rats were operated on for the removal of the anterior and posterior lobes of the pituitary gland The age of the rats at the time of operation ranged from 92 to 247 days, the average being 126, while the day of pregnancy varied from the eleventh to the twentieth, most being within the twelfth to the sixteenth

Of the 43 operations, 21 resulted in the incomplete removal of the gland, for at necropsy it was easy to find under a dissecting binocular small pieces of anterior lobe, or of anterior and posterior lobes, *in situ*

In all the foregoing 21 rats, gestation ended in parturition, the young in most cases being alive In 18 of these rats the gestation period was of normal length, and all the newborn were living and were suckled Pregnancy in the other 3 animals was prolonged One mother gave birth to 2 living young and 3 dead on the twenty-fifth day, one of the litter showing signs of having milk in its stomach On necropsy a very small piece of the anterior lobe was found to have been left The second mother gave birth to one dead and one living young at 11 A M on the twenty-fourth day of pregnancy Three hours later two more living young were found in the cage. The following morning all were dead, apparently without having been suckled by the mother. The mother was killed the same day and was found to contain *in utero* one macerated foetus, and at the site of the pituitary a small piece of the gland In the third case, on the twenty-fifth day one was found born alive Necropsy revealed no others *in utero,* although there was evidence of others probably destroyed after birth Traces of pituitary tissue were found

Twenty-two of the 43 pregnant rats used in the experiment retained none of the pituitary Microscopic findings will be reported later In all these the period of pregnancy was lengthened by from 3 to 4 days With two exceptions, noted below, the mothers died without being able to give birth to their young One of the two exceptions was sacrificed on the twenty-sixth day in order to secure good necropsy material In the other exceptional case, the young were removed by caesarian section on the twenty-fifth day, the result of which was that the mother recovered At necropsy a month later, the former site of the pituitary showed no traces of the gland, and the ovaries, uterus, thyroid and adrenals exhibited all the characteristics of a completely hypophysectomized animal

The evidence at hand thus shows that complete removal of the pituitary is followed by death at the end of a prolonged pregnancy, unless, as in one case, the mother's life is saved by removal of the foetuses from the uterus

R I Pencharz
J A Long

Department of Zoology,
University of California

BOOKS RECEIVED

Baur, Erwin, Eugen Fischer and **Fritz Lenz** *Human Heredity* Translated by Eden and Cedar Paul Pp 734 171 figures Macmillan $8 00

Bureau of Commercial Fisheries, Division of Fish and Game of California Handbook of Common Commercial and Game Fishes of California Lionel A Walford Pp 183 137 figures The Striped Bass of California Eugene C Scofield Pp 84 47 figures The Commercial Fish Catch of California for the Year 1929 The Staff of the Bureau of Commercial Fisheries Pp 155 75 figures Studies of the Length Frequencies of the California Sardine California State Fisheries Laboratory. Pp 53 25 figures California State Printing Office

Edge, A. B Broughton and **T H Laby**, Editors *The Principles and Practice of Geophysical Prospecting*. Being the Report of the Imperial Geophysical Experimental Survey Pp ix + 372 261 figures Cambridge University Press, Macmillan. $5 00

Felix, Edgar H *Television, its Methods and Uses.* Pp. x + 272 73 figures McGraw-Hill. $2.50

Smith, Walter B. *The Jones Cove Shell Heap at West Gouldsboro, Maine.* Pp. 28. 26 figures. *The Lost Red Paint People of Maine.* Pp 43. 29 figures. Lafayette National Park Museum

---

[1] Aided by a grant from the National Research Council.

SCIENCE

Vol. 74 FRIDAY, AUGUST 28, 1931 No. 1913

The Harvard Program of Galactic Explorations: Dr. Harlow Shapley 207

Obituary:
- *Frank Wigglesworth Clarke:* Professor L. M. Dennis. *Memorials; Recent Deaths* 212

Scientific Events:
- *Dissolution of the Royal Botanic Society; Opportunities for Employment of Engineering Graduates; The New York State Geological Association; Symposium of the American Chemical Society* 213

Scientific Notes and News 216

Discussion:
- *Why the Angiosperms are Old:* Professor G. R. Wieland. *The Occurrence of Phylloerythrin in the Digestive System of Herbivorous Animals:* Professor O. L. Inman and Paul Rothemund. *Fresh Water Medusae in Oklahoma:* Dr. A. I. Ortenburger and George R. Phillips. *The "Fire Stopper":* Dr. Ferdinand W. Haasis 219

Special Correspondence:
- *International Physiological Congress Fund Fellowships:* Professor Howard B. Lewis 223

Scientific Apparatus and Laboratory Methods:
- *A Simplified Instrumental Method of Measuring Sound Absorption Coefficients:* Professor James F. Mackell. *A New Dehydrating Agent for Histological Technique:* Professor O. C. Bradbury 224

Special Articles:
- *On the Relative Sterility of the Adolescent Organism:* Dr. Carl G. Hartman. *The Etiology of Epizootic Encephalomyelitis of Horses in the San Joaquin Valley, 1930:* Dr. K. F. Meyer, Dr. C. M. Haring and B. Howitt 226

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE HARVARD PROGRAM OF GALACTIC EXPLORATIONS

By Dr. HARLOW SHAPLEY

DIRECTOR OF THE HARVARD OBSERVATORY

The work carried on at the Harvard Observatory for the past ten years has included the systematic survey of various parts of the stellar universe. Recently we have been able to inaugurate active studies in the whole range from the nearest stars to the groups of galaxies at distances of the order of a hundred million light years. For convenience of operation and discussion the program of exploration and measurement has been divided into eight major sections, each concerned with a separate territory and employing in general a special method and equipment. Ten photographic telescopes and approximately thirty observers and investigators are involved in the program. In the following paragraphs I shall outline briefly the progress in the eight territories, of which five lie within the galactic system and three in the extragalactic universe.

(1) The Solar Neighborhood

A large majority of the stars within fifty light years of the sun are of less than solar luminosity, and most of them are below naked-eye visibility. Thus a recent compilation of those stars known to be nearer than sixteen light years shows but 40 per cent. brighter than the sixth magnitude. The exploration of the solar neighborhood is therefore a search for dwarf stars among telescopic objects.

It is important to have as complete a census as possible of the solar neighborhood—the most useful sample we have of a volume of space. A thoroughly observed frequency distribution of stellar luminosities and a knowledge of the density-in-space laws for the stars within fifty light years of the sun are fundamental in the analysis of stellar development and the structure of stellar systems.

The Harvard work on the space distribution of nearby stars is at present confined to the southern hemisphere and consists in the detection of these stars, not through parallax measures, but through their large proper motions. Photographs made with the 24-inch Bruce doublet at the southern station (now near Bloemfontein, South Africa) cover practically all the southern sky for stars to the seventeenth magnitude and about one fourth of the southern sky for stars to the eighteenth magnitude. Many of the plates were made more than thirty years ago. A comparison of these plates (scale 1′ = 1 mm) with the plates made currently on the same fields with the same telescope will provide much material on the number and on the distribution in space and in luminosity of the stars in the circumsolar region. At present approximately 40 per cent of the telescope's working time is devoted to proper motions, and already a large number of conspicuously moving stars have been found on the Bruce plates by Dr. Luyten, who continues at the University of Minnesota the study begun at Harvard.

(2) THE REGION OF THE BRIGHTER STARS

The great majority of naked-eye stars lie between the distance limits of fifty and five hundred light years, though some of them with unusually high intrinsic luminosities are farther away. Within the same limits of distance are probably half a million telescopic stars. Their distribution in space and the general structure of the stellar system which they compose can be determined in part from studies of proper motion and trigonometric parallax. The naked-eye stars of the region can probably be most effectively studied, however, through those methods of distance measurement that depend on knowledge of the absolute magnitudes (intrinsic luminosities) of the stars as estimated from their spectra. With the absolute magnitudes known and apparent magnitudes measured, distances are readily computed.

Our own explorations of this territory are very largely based on spectroscopic parallaxes. For several years at both the southern and the northern stations we have systematically accumulated spectrograms suitable for the work, methods of using the various classes of spectra are under study at Harvard and elsewhere and it appears probable that good criteria of absolute magnitudes will soon be available for many of the spectral classes. We can use in this survey not only the plates specially collected for the purpose but also the tens of thousands of short dispersion spectrum plates in the Harvard photographic collection. The analysis can thus go several magnitudes below the naked-eye limit, extending the territory to the distance of a thousand light years or so, and making possible a much more complete census of the dwarf stars within a few hundred light years of the sun.

(3) THE LOCAL SYSTEM

We have good but not incontrovertible evidence of the existence of a localized star cloud in our part of the galaxy. Its diameter is several thousand light years, its population is in the tens or hundreds of millions of stars. I believe that this local system may be comparable in dimensions and composition with the Magellanic clouds or with a typical spiral nebula. But it will take long and laborious study to unravel the complications of stellar structure in this third territory which, we assume, extends out to a distance of approximately five thousand light years.

The Henry Draper Catalogue gives the spectra of 225,000 stars as classified by Miss Cannon, and affords material for the statistical discussion of their space distribution. Most of the stars, however, to the magnitude limit within which the catalogue is essentially complete, are not more distant than one or two thousand light years, they do not represent satisfactorily the local system.

Nearly ten years ago we began an extension of the Henry Draper Catalogue to the fainter stars, paying special attention to the rich regions in low galactic latitude. The new spectrum plates required for the work were made at the southern station, mainly with the Metcalf 10-inch camera. A hundred thousand faint spectra have now been classified for the Henry Draper Extension. The limiting photographic magnitude of completeness is approximately 11.5, corresponding to a fourfold extension in distance over the Henry Draper Catalogue. The distance limits are, of course, quite different for the various spectral classes, because of the diversity in absolute magnitude from class to class.

Scarcely one fourth of the Milky Way has been covered at the present time by the Extension, but preliminary analyses have already shown that the new work will be of much value in advancing our knowledge of that nearer part of the Galaxy which we call the Local System. An equally useful result of the program will be the determination and the publication of spectra and magnitudes of great numbers of individual faint stars, thus giving the students of positions, motions and luminosities basic data for their investigations.

For the work on spectral classification, as for the projects in several of the other territories under exploration, the measurement of the stellar magnitudes is fundamental. To provide the necessary standards of photographic brightness, the Harvard photometric program has been taken up actively again after an interruption of several years.

(4) The Milky Way

The stars within five thousand light years of the sun constitute a trifling proportion of the galactic system as outlined by globular star clusters and the Milky Way clouds. The faint stars of the Milky Way are so remote that spectroscopic methods of determining their distances are as yet quite impossible, and trigonometric and proper motion measures are hopelessly inadequate. Statistical analyses, based on the counts of stars of various magnitudes, assist in discovering the structure of the nearer parts of the Milky Way, but perhaps now the most satisfactory attack on its extent and structure can be made through the study of the periods and light curves of variable stars The methods of using eclipsing binaries, long period variables, novae, and Cepheid variables in the measurement of stellar distances are well known to the students of stellar astronomy The Cepheid variables are especially powerful in measuring space, through the fortunate circumstance that the lengths of their periods of variation are closely correlated with their absolute magnitudes The period-luminosity relation for Cepheid variables is the key to the measurement of practically all distances greater than a few thousand light years.

About seven years ago a program for the systematic photography of Milky Way variable stars was inaugurated at our northern and southern stations to supplement the plates of the Harvard sky patrol, which had been in operation for approximately thirty years. The regular patrol furnishes ample material for the three or four thousand variable stars brighter than the twelfth magnitude, but it contributes little for the fainter variable stars associated with the Milky Way star clouds In the new observing program, which is carried on with the larger telescopes at Cambridge and Bloemfontein, several thousand photographs have been taken The whole of the galactic belt is covered systematically. In three lines along the galactic circle 196 regions have been chosen, so centered that adjacent fields overlap For purposes of comparison seventy-two variable star fields in various high galactic latitudes have also been selected for study. Particular attention is given at present to the southern Milky Way, not only because of its greater richness in variable stars and in other objects of interest, but because the northern sky is being more actively studied than the southern by other observatories.

The photographs of ten of the Milky Way fields have been examined by the workers in Cambridge, who have found nearly two thousand new variable stars and have determined the periods and light curves of several hundred. The photographs extend to the sixteenth magnitude and fainter, and many of the new variables are more than thirty thousand light years distant. The work shows conclusively that the variable stars provide an easy entry into the Milky Way star fields in which they are imbedded, but the labor of discovery and analysis is very great, and it will be ten or fifteen years before a sufficient number of the Harvard Milky Way fields are studied fully enough to outline the arrangement and dimensions of the star clouds composing the Milky Way system

The regions so far studied are mainly in the Milky Way between Carina and Aquila One of our first results on this program was the discovery that the dense star clouds in Sagittarius and neighboring constellations are at a distance of forty or fifty thousand light years Apparently they form a nucleus of the Milky Way system, near the gravitational center of the surrounding system of globular star clusters. They indicate a center that agrees both in direction and in distance with the galactic center found ten years before from the study of the space distribution of individual globular clusters.

Concurrently with the systematic work on faint variable stars in the Milky Way, which is under the supervision of Miss Henrietta Swope, we have undertaken several special studies of the nearer variable stars (a) With the help of a grant from the American Academy of Arts and Sciences an investigation of the photographic brightness of eclipsing stars has been made, providing the first extensive material available on photographic light curves of a type of variable star important to our knowledge of the shapes, surface brightnesses and mean densities of stars in binary systems, and significant therefore for theories of stellar evolution (b) Harvard patrol plates have been used by Dr L. V Robinson to determine from about fifty thousand observations the photographic light curves of one hundred of the brighter Cepheid variables in an attempt to learn more of the characteristics of these stars on the basis of homogeneous material (c) Participation by the Harvard Observatory in an international study of Cepheid variables in selected regions during the past two years has involved the measurement of sixty-two magnitude sequences, the accumulation of a thousand new photographs of the "international" Cepheids, the study of their spectra and the detailed investigation of their periods and mean photographic light curves. (d) The study of faint variables in three large fields in high galactic latitude has revealed an abundance of cluster type Cepheids and of eclipsing binaries but relatively few long period variables and no classical Cepheids, indicating the thinness of the Milky Way system.

(5) THE SYSTEM OF GLOBULAR CLUSTERS

The diameter of the Milky Way is not less than a hundred thousand light years, probably it is much larger Undoubtedly the globular star clusters which are observed along the borders of the Milky Way and sparingly in high galactic latitudes extend throughout a region more than two hundred and fifty thousand light years in diameter The galactic system may be coextensive with this system of globular clusters, and it may be that the globular clusters, with the star clouds of the Milky Way, the local system and the Magellanic clouds, form a complex system of higher order than a simple galaxy In time we should know much about these matters It is convenient for the present to consider that the supersystem of a hundred globular clusters constitutes the fifth stage in our explorations and marks the point where we pass from considering various parts of the galactic system to the treatment of external galaxies

The discovery and study of variable stars in globular clusters by the late Professor Bailey at Harvard was followed by the extensive investigations of such systems with the Mount Wilson reflectors and by further photometric researches at Harvard At the present time we know more about this territory than about any of the others The results are summarized in a recent monograph[1] To extend the work on these systems and on other extra-galactic objects in the southern hemisphere, a 60-inch reflecting telescope has been obtained for the station at Bloemfontein Within a year it should add greatly to our information about the luminosity curves, variable stars, density distribution, and internal structure of globular systems, since the nearer and brighter examples of the class are too far south for analysis with northern telescopes

Current studies of globular clusters at Harvard include a new determination of the period-luminosity relation, investigation of the small amplitude variations for stars in Messier 3 of the same luminosity and color as cluster type Cepheids, derivation of luminosity curves of the giant stars in northern clusters and the construction of contour maps of the luminosity distribution for a few of the brighter systems

(6) THE CLOUDS OF MAGELLAN

The present and forthcoming work on the spectra, light variations, and distribution and motions of the stars in the Magellanic clouds, and the study of their clusters and nebulae, will reflect on the problems of our local system and of the similar star clouds in the Milky Way But as the nearest of isolated external galaxies, the clouds of Magellan should serve primarily as leads to knowledge of the millions of extragalactic systems, for these large and complex stellar organizations in the southern sky are immediately related to spiral and spheroidal nebulae Studies of the clouds have, in the past, included the detection of peculiar spectra, the determination of the period-luminosity relation by Miss Leavitt, the measurement by R E Wilson and others of the radial velocities of the included gaseous nebulae, studies of motions by Hertzsprung and Luyten, and the discovery and cataloguing of variable stars, gaseous nebulae and star clusters by various Harvard investigators

Current Harvard work on the Magellanic clouds includes the following studies

(a) An analysis of the number and distribution of giant and supergiant stars in the Large Magellanic Cloud, which has become possible (for the first time in any galaxy) through the establishment of standard magnitudes in the cloud

(b) The classification of spectra of supergiant stars in the Large Cloud, including those of peculiar types with luminosities of more than ten thousand times that of the sun, Miss Cannon has classified more than three thousand of the faint spectra, most of which, however, are foreground stars in our own galaxy

(c) The determination of the magnitudes of the brightest individual stars in one hundred and sixty open star clusters in the Large Cloud

(d) The discovery of several hundred new variable stars in the Large Cloud, in which Miss Leavitt had previously found eight hundred, on the basis of the new discoveries, which were made on recent plates from Bloemfontein, I estimate that the total number of Cepheid variables in the Large Cloud is not less than three thousand.

(e) The determination of periods and light curves of about seventy-five Cepheid variables in the two clouds, showing that the period-luminosity relation holds for the Large Cloud as for the Small, and that the Cepheids in external galaxies are similar in amplitude of variation and in form of light curve to those in our own galactic system

Future work on the Magellanic clouds will include an analysis of globular clusters within them, studies of the variable stars in these clusters, classification of the spectra of the highly luminous stars in the open clusters, further studies of the velocities in the line of sight—not only of the easily measured gaseous nebulae but also of the stars themselves, studies of variable stars fainter than those now attainable and the extension of the luminosity curves toward the dwarf stars for each spectral class separately. All of these researches should be carried forward rapidly with the aid of the new 60-inch reflector.

---

[1] Harlow Shapley, "Star Clusters," Harvard Observatory Monograph No 2, McGraw Hill Book Company, New York, 1930

In the investigations of the clouds of Magellan we take full advantage of our position as external observers, future studies will still further exploit this advantage of objectivity.

(7) The Supergalaxies

The clouds of Magellan are serviceable representatives of the numerous external galaxies that lie within two or three million light years of the earth To explore more remote regions satisfactorily we can take advantage of the tendency of external galaxies to form higher systems These supergalaxies, or clusters of extragalactic nebulae, yield to the same type of analysis that we have used for star clusters The use, for individual galaxies, of relative diameters and relative brightness as criteria of relative distance is unsafe, but the method can be employed with some success when mean values are obtainable for the several members of a supergalaxy

Approximately forty clusters of galaxies are now distinctly shown on the Bruce plates at the Harvard Observatory Their distances range from a few million to a hundred million light years The current studies of these higher systems include the measurement of magnitudes, dimensions, positions and orientations of the individual members The extension of the survey with long-exposure photographs to all regions of the southern sky will undoubtedly increase the number of known supergalaxies and add to our information of their distribution in space

The most conspicuous supergalaxy under study at the present time is Coma-Virgo Cloud A, which is a stream of several hundred bright spiral, spheroidal and irregular galaxies extending over about sixty degrees of the sky Its distance from the earth is approximately ten million light years, and its greatest length at least half as much

(8) The Metagalaxy

Two systematic surveys of external galaxies which are now in progress at Harvard concern the all-inclusive order which we call the metagalaxy Of the two, the less ambitious is a catalogue of the photographic magnitudes of all external galaxies brighter than magnitude 13 0 This survey will include something less than a thousand objects The magnitudes are based on numerous small scale photographs The second systematic survey reaches to the eighteenth magnitude and fainter, and will probably require at least ten years for completion It will involve the finding and the study of tens of thousands of heretofore uncatalogued objects, the measurement of their positions, approximate magnitudes and diameters, and their classification on a system peculiarly suited to the scale of the Bruce photographs.

The survey of bright objects may be assumed to extend five million light years into space, though undoubtedly many of the intrinsically fainter galaxies within that limit of distance are not recorded, and many of the high luminosity galaxies will appear in the catalogue though lying considerably more than five million light years distant The second survey will extend to objects five magnitudes and more fainter and will reach, we may assume in a first approximation, to an average distance of fifty million light years We are sure, however, that several of the supergalaxies found among the faintest objects are more than a hundred million light years away

Approximately one sixth of the whole sky has been covered in the eighteenth magnitude survey More than twenty thousand new systems have been found For 75 per cent of them positions have been determined and for 58 per cent classifications have been made on the Harvard system The number of galaxies per square degree has been counted on a large number of Bruce plates, and conspicuous deviations from uniform distribution are revealed (in addition to the well-known apparent avoidance of low galactic latitudes which is the result of obscuration by dark nebulosity) Equally distinct dissimilarities from field to field are found in the magnitude distribution, indicating that along the line of sight as well as on the surface of the sky the distribution is far from uniform Taking the whole sky we find, in agreement with Hubble's results with the Mount Wilson reflectors, that the increase in numbers with decreasing brightness is approximately of the order of magnitude appropriate to uniform density in space, though for various large sections of the sky the uniformity criterion fails conspicuously

As a whole, our surveys of the metagalaxy, which cover large and representative sections of the sky, give no evidence that we have measurably approached the limits of the galaxy-populated universe, we have no indication that the systems are falling off in number as we go out from our galaxy On relativistic grounds the red shift in the spectra of distant objects can be taken as an observational indication of an expanding universe that is finite, but so far as the present census of the metagalaxy goes, the total number of galaxies and the radius of space may both be infinite.

The studies of the various territories in which our explorations proceed are closely interwoven. For instance, the luminosity curves for the solar neighbors will be of direct application in work on the integrated luminosities of the Magellanic clouds and of other external galaxies, the frequency of Cepheids in the Magellanic clouds will bear on the interpretation of results in the Milky Way; variable star fields a comparison of the structure of the local system with that of external galaxies will eventually determine whether our galaxy is a unit organization or a supersystem, and the researches on the anatomy of bright southern globular clusters, throwing light on the nature of the faintest spheroidal galaxies, will aid in the measurement of the metagalaxy

OBITUARY

FRANK WIGGLESWORTH CLARKE

ON May 23, 1931, Frank Wigglesworth Clarke, one of the most widely and favorably known of American chemists, quietly passed away at his home in Chevy Chase, Maryland, at the age of eighty-four years

Dr Clarke was born in Boston, March 19, 1847. He was the great-great-grandson of Robert Clarke, of the Scotch colony near Londonderry, Ireland, who came to this country about 1725

Dr Clarke's early education was obtained in schools in and near Boston, and in March, 1865, he entered the Lawrence Scientific School of Harvard University where he took up the study of chemistry under Wolcott Gibbs Receiving the degree of Bachelor of Science in 1867, he remained at the School for another year, and published his first scientific paper, "A New Process in Mineral Analysis," in the *American Journal of Science* in 1868 In January, 1869, he went to Cornell University as assistant to Professor J M Crafts and, leaving that position at the close of the academic year, he returned to Boston where for the next four years he lectured on chemistry in the newly established Boston Dental College and eked out his small income by lecturing in other schools and by journalistic work

From early boyhood he had a strong bent toward the preparation of collections—stamps, coins, flowers and especially minerals—and of tabulations of the facts that came to him through observation or reading This characteristic of his orderly mind led him later to compile a "Table of Specific Gravities, Boiling Points and Melting Points of Solids and Liquids," which was accepted for publication in 1872 by Professor Joseph Henry, secretary of the Smithsonian Institution, who gave to the paper the general title "Constants of Nature, Part I" Further volumes under this title followed in 1876, 1882, 1888 and 1897.

After one year as professor of chemistry and physics at Howard University, Dr Clarke accepted appointment in 1874 to the chair of chemistry and physics in the then new University of Cincinnati where he remained until, in 1883, he went to Washington as chemist of the United States Geological Survey and honorary curator of minerals of the United States National Museum, positions that he held until his retirement on December 31, 1924.

The investigations by Dr. Clarke and his associates in the Survey were of the most varied character, and the wide range of the topics of their many bulletins in the publications of the Survey affords abundant evidence of Dr Clarke's striking ability as a director of research and as a chemist of unusual versatility and breadth of interest.

He early began the collection of data relative to the determination of atomic weights, and presented his first paper on the subject at a meeting of the Subsection of Chemistry of the American Association for the Advancement of Science, held at Saratoga in August, 1879 In 1882 there appeared from his pen a comprehensive monograph of 271 pages entitled "A Recalculation of the Atomic Weights," which attracted wide attention not only in this country but also in Germany and Norway, where similar revisions had been prepared. In 1892, the American Chemical Society requested him to prepare an annual report on the subject, and to compile annually a table of atomic weights for official use in this country This he did until 1903, when an International Committee on Atomic Weights was created with Professor Clarke as chairman, a position that he continued to hold until 1922

His article upon "The Relative Abundance of the Elements" appeared in 1889, and through all the following years it has stood as a classic on this subject.

One of his greatest services to chemistry in this country was in connection with the creation of the American Chemical Society Up to 1873, chemistry had been given but scant attention in the meetings of the American Association for the Advancement of Science. In that year, at the meeting at Portland, Maine, four young men, C E Munroe, W McMurtrie, H. W. Wiley and F W Clarke, presented a request that chemistry be more adequately recognized by the formation of a subsection of chemistry, now Section C. The request was granted, and the section held a successful meeting at Hartford in the following year. In 1876 the chemists of New York City organized a local society to which they gave the name American Chemical Society, and some eight years later another local society of chemists was formed in Washington. The American Association met at Cleveland in 1888, the chairman of the chemical section at that time being Dr. C. E. Munroe. Dr. Clarke wrote to him and suggested the formation of a really national Chemical Society. Dr. Munroe favored the idea, and after some three years of discussion of the project, in which Dr. Clarke took an active part, a compromise proposal of the New York Society was adopted. This was, that if the chemists of the country would accept the name and charter of the New York organization, that society would form a local section of a truly national society, the Washington society to take the same action This national society has now become the largest chemical society in the world, with eighty sections and over 17,000 members Dr Clarke was elected to the presidency of the society in 1901

The numerous articles from his pen upon a wide variety of subjects that appeared in divers journals and magazines furnish abundant evidence of the breadth of his interest and the scope of his knowledge and of his gift of felicitous and convincing expression The high esteem in which he was held by scientists both in this and foreign countries is shown by the number of honorary degrees that were conferred upon him, and by his election to honorary membership or emeritus life membership in American, English and Russian scientific societies

Dr Clarke was one of the most kindly and lovable of men, simple in his tastes and of a modesty that is so generally a characteristic of the really great His sense of humor and ready wit gave to his conversation a delightfully piquant flavor and it was a most entertaining experience, which the writer often had the privilege to enjoy, to listen to his reminiscences, sometimes keenly critical, sometimes highly amusing, but always sympathetically appreciative, of the noted men whom he had known and of their scientific work His was a long life, a happy and useful life, a life of helpfulness to others and of high achievement

L. M Dennis

Cornell University

MEMORIALS

The dedication of Fine Hall, Princeton University, will be held in the early fall at a time when it will be convenient for Miss Gwethalyn Jones, of Chicago, who, with her uncle, the late Thomas D Jones, '76, of Chicago, gave the building to the university, to attend the exercises. The building, which was recently completed at a cost of $500,000, was given in memory of Dean Henry Burchard Fine, '80, who organized and developed the present department of mathematics of the university. It will contain all classroom and research work in mathematics It is the seventh scientific building on the campus.

We learn from the *Journal* of the American Medical Association that Dr. Cornelius A. Harper, Madison, president of the State Medical Society of Wisconsin, will dedicate a bronze tablet to the memory of Dr. William Beaumont on the site of Fort Crawford, near Prairie du Chien, on August 30 Speakers at the dedication ceremonies will be Dr William Snow Miller, on "Beaumont the Man", Dr. Walter J. Meek, "Beaumont the Physiologist," and Dr Peter L. Scanlan, "Old Prairie du Chien." The site for the monument was presented to the medical society by the Daughters of the American Revolution The inscription on the tablet is as follows "William Beaumont, M.D, Pioneer in Physiology, born Lebanon, Conn., 1785; died St. Louis, Mo, 1853 At old Fort Crawford, one and one half miles northwest of this spot, one hundred years ago, Doctor Beaumont, a surgeon in the U S Army, performed those experiments on Alexis St Martin which laid the foundation for our knowledge of digestion In honor of his pioneer work this memorial has been erected by the State Medical Society of Wisconsin, 1931."

RECENT DEATHS

Dr Aristides Agramonte, professor of bacteriology and experimental pathology at the University of Havana and well known for his work on yellow fever, died on August 17, at the age of sixty-two years

Dr William H Hunter, chief of the division of organic chemistry in the school of chemistry at the University of Minnesota, died on August 19, aged forty-nine years

Dr. Charles H Shattuck, vice-president of the Howard Pulp and Paper Company, and formerly professor of forestry at the University of California, died on August 13 at the age of sixty-four years

Morgan P Sweeney, for twenty-two years a member of the division of chemistry at the New York State Experiment Station at Geneva, died on August 6, following a brief illness.

Dr. J. D Robertson, formerly commissioner of health and president of the board of education in Chicago, died on August 20, at the age of sixty years

Dr. Archibald Barr, chairman of the engineering firm of Barr and Strand, Ltd., and formerly Regius professor of civil engineering and mechanics at the University of Glasgow, died on August 6, at the age of seventy-six years.

SCIENTIFIC EVENTS

DISSOLUTION OF THE ROYAL BOTANIC SOCIETY

According to an article in the London *Times*, the dissolution of the Royal Botanic Society at the end of this year was accepted as inevitable by a meeting of fellows held recently at the Royal Botanical Gardens. The lease of the gardens from the Crown does not expire until April, 1932, but the finances of the society are attenuated and it is only by a reduction of the staff and the sale in the autumn of plants and other property that the remaining fellows may enjoy their facilities for a few months more and the society can meet its obligations in keeping with its honored traditions

Mr H J Greenwood, who presided at the meeting, said he was sorry that nothing had transpired since they last met of a hopeful character regarding the future of the gardens Many of them, perhaps, had not been very sanguine that the decision would be materially changed Efforts had been made by a large number of fellows, and more particularly by Colonel Moore, to keep in touch with the Minister of the Crown affected, but, in view of the grave situation in the world, members of the cabinet would not be able to give consideration to the matter of the gardens at the present time Apart from that, he reminded the meeting that it was determined some years ago that the whole of the Crown leases in private hands were to be reviewed and treated in an economic way When, in the early days of the consideration of the future of the gardens, the council made an offer of £2,000 for a further lease, if granted, they were advised that the sum likely to be required for this inner circle would probably be £3,000 to £5,000 a year It was obvious that even in a mood of optimism efforts to meet such a rent would have been doomed to failure In any case they had to face the definite statement that there would be no renewal of the lease

The Duchess of Hamilton, who elicited the fact that the curator had the longest service of the officials of the society who were to go, paid a tribute to the work of Mr North, and recalled that he began the cultivation of the soya bean, which might one day be of great help to agriculture

The chairman, having intimated that it was proposed that a testimonial should be opened for the staff of the society, accepted a proposal that it should be done at once, and subscriptions were made during and at the close of the meeting It was also stated that the government had asked for, and had been given, particulars of the age and length of service of the staff

Colonel T C Moore, M P, gave a short account of his efforts to secure the preservation of the gardens While hopes had not actually materialized, he said, they were not without possibility of coming to fruition. With the support of the council he had approached the Pilgrim Trust for a contribution towards the upkeep of the society, and through Sir Ernest Graham-Little had tried to find out what the London University Senate might do The Pilgrim Trust did not meet until the latter part of September, but full details had been collated for them. To Mr Lansbury he had submitted alternative suggestions One, that, subject to the Pilgrim Trust and the university cooperating to maintain the integrity of the society, the lease should be renewed under new and more democratic conditions, had not much chance of acceptance The other was to agree that the society should lapse and that the government should take over the gardens and administer them, offering facilities to subscribing fellows, but providing for the admission of the public, and with two free days That was a scheme which he thought might appeal to Mr Lansbury, and it had been promised full consideration.

OPPORTUNITIES FOR EMPLOYMENT OF ENGINEERING GRADUATES

A FORTY per cent increase in enrolment in the engineering schools of the country during the past five years narrows professional possibilities in some of the fields, as the saturation point approaches, according to a statement made to a representative of the *U S Daily* by Mr W C John, specialist in professional education at the Federal Office of Education

The total enrolment in 145 leading engineering schools reached 78,685 during 1930–1931, of whom 12,161 were undergraduate seniors and 2,939 students of graduate engineering

The problem of the placement of graduates of engineering schools becomes more difficult as the number of students increases Reports collected by Mr. F L Bishop, secretary of the Society for the Promotion of Engineering Education, indicate that but 38 2 per cent of the graduates of 88 institutions have been placed this year The report involved 5,866 graduates, of whom only 2,240 obtained positions

The latest statistics on engineering education are now in process of compilation by the Office of Education and will soon be available for public distribution. These statistics will show a great increase in the number of students pursuing some phase of engineering The four leading fields are electrical, mechanical, civil and chemical engineering, with mining and metallurgy ranking fifth in popularity.

Nearly 20,000 students were enrolled in electrical engineering courses alone in 1930–1931. Of these, 18,565 were undergraduates More than 15,500 were pursuing mechanical engineering with over 15,000 enrolled as undergraduates

Civil engineering ranked third in popularity with a total enrolment of over 14,500, of which 13,813 were undergraduates Next in order was chemical engineering which mustered over 9,600. Of these, 9,154 were undergraduates Mining and metallurgy were represented by nearly 3,000. Mr. Bishop's study on placement of students from the 88 institutions reporting indicates that 33 4 per cent of the electrical engineering group were placed, 41 per cent. of the mechanical, 37.5 per cent. of the civil and 46.3 per cent. of the chemical. In mining 45 1 per cent were placed and in industrial engineering, 44.2 per cent. It was found that institutions west of the Mississippi placed about 3 per cent more students than those east Colleges in urban centers have placed about 5 per cent less of their graduates

The survey covers enrolments in 41 separate fields of engineering to which are added special and unclassified groups

A study of the total distribution of students of engineering throughout the four years shows that more than 50 per cent do not reach the senior year while 2,360 enter graduate work

For the session 1930–31, a total of 25,332 students enrolled in freshman courses, 19,631 in sophomore courses, 16,262 in junior and 12,161 in senior courses There were 73,386 undergraduates

In recent years there also has been a notable tendency for students to continue higher studies after completing their undergraduate work

THE NEW YORK STATE GEOLOGICAL ASSOCIATION

The seventh annual field meeting of the New York State Geological Association was held at Port Henry on May 15 and 16, under the presidency of Dr Harry N Eaton, of Elmira College Dr O D von Engeln, of Cornell University, was secretary About 115 persons were in attendance representing twenty different institutions Dr D H Newland, Dr R Ruedemann and Mr. C. A Hartnagel, of the New York State Museum, acted as field leaders The region chosen for the excursions is one of great natural beauty, rich in historic associations and classic from the standpoint of pre-Cambrian and mining geology

Upon meeting at Fort Ticonderoga on Friday, the party moved to Fort Crown Point and Port Henry studying the fine exposures of the early Paleozoics of the Crown Point Peninsula, and observing the glacial deposits and evidences of marine transgression North of Port Henry were seen pre-Cambrian igneous rocks, metamorphosed sediments of the Grenville series, and faults between the pre-Cambrians and the Paleozoics.

During Saturday forenoon a trip was made to Mineville (six miles) to study the great magnetite ore body in the pre-Cambrian and the mines of the Witherbee-Sherman Company which have been worked for many years.

At the dinner on Friday night talks explanatory of the local geological features were made by Drs. Ruedemann and Newland, and Dr. H. L. Alling showed a series of microphotographs to illustrate the origin of the magnetite ore.

The invitation of the University of Rochester to act as host for the meeting in 1932 was accepted. Dr. H L. Alling and Dr. J E. Hoffmeister were elected president and secretary, respectively, for the ensuing year.

SYMPOSIUM OF THE AMERICAN CHEMICAL SOCIETY

A symposium on "New Research Tools" will be held in Buffalo on August 31, as the opening event of the eighty-second meeting of the American Chemical Society The chairman of the symposium will be Dr Karl Taylor Compton, president of the Massachusetts Institute of Technology, who in cooperation with other investigators has selected twelve new research tools for discussion

The twelve fields to be discussed are roughly divided into three groups Speakers and their topics on radiation and atomic structure are Professor Donald H Andrews, the Johns Hopkins University, "The Use of Raman Spectro in Qualitative Analysis", Professor George L Clark, University of Illinois, "X-Rays as a Research Tool in Chemistry and Industry", Professor Worth H Rodebush, University of Illinois, "Molecular Beams", Professor Charles P Smyth, Princeton University, "Dipole Moments"; Professor Harold C Urey, Columbia University, "Molecular Spectra"

Speakers at a second group of subjects, dealing with new advances and applications of certain practical tools, are Dr Saul Dushman, General Electric Research Laboratory, "New Gauges", Dr Per K. Frolich, Standard Oil Development Company, "Catalysis"; Professor Frederick G Keyes, the Massachusetts Institute of Technology, "High Pressure Technique", Dr W A Peters, Jr, E B Badger and Sons, New York, "Distillation", Dr Robert B Sosman, U. S. Steel Corporation, "High Temperature Technique", Dr Lewis R Koller, General Electric Research Laboratory, "High Temperature Control."

Various aspects of micro-analysis comprise a third group of topics, the speakers being Professor Fred Allison, Alabama Polytechnic Institute, "Microanalysis of Solutions", Professor E. M. Chamot, Cornell University, "Micro-analytical Methods as Time and Labor Savers"; Dr. Frederick G Cottrell, U S Department of Agriculture, "Micro-analysis of Gases"; Dr. J B Nichols, E I. du Pont de Nemours & Co., "The Ultra-Centrifuge and its Field of Research"

The committee which, with Professor Compton, selected the topics and speakers included the following representatives of pure science· Professor Roger Adams, head of the department of chemistry of the University of Illinois; Wilder D Bancroft, professor of physical chemistry of Cornell University; Dr. Frederick G. Cottrell, of the Bureau of Chemistry and Soils of the U. S Department of Agriculture; William D. Harkins, professor of chemistry, University of Chicago; Dr. Arthur A. Noyes, director of the Gates Chemical Laboratory of the California Institute of Technology, Professor Hugh S Taylor, chairman of the department of chemistry at Princeton University

Committee members representing industrial research groups were Dr. Harrison E Howe, editor of *Industrial and Engineering Chemistry*, Dr John Johnston, director of research, U. S Steel Corporation; Dr. Arthur D. Little, of A. D Little, Inc., Cambridge, Massachusetts; Dr C E K. Mees, director of research, Eastman Kodak Company, Dr. Willis R. Whitney, director of research, the General Electric Company, Dr. Robert E. Wilson, vice-president in charge of development, Standard Oil Company of Indiana.

SCIENTIFIC NOTES AND NEWS

The thirty-fourth anniversary of the discovery by Sir Ronald Ross of the transmission of malaria by anopheles mosquitoes was celebrated on August 20 at the Ross Institute in Putney, London Dr William H. Welch, professor of the history of medicine at the Johns Hopkins University, and Mr John Masefield, poet laureate of Great Britain, gave the principal addresses.

Dr. William J Holland, director emeritus of the Carnegie Museum, Pittsburgh, celebrated his eighty-third birthday on August 16

Dr. Linus Pauling, professor of chemistry at the California Institute of Technology, will receive the A. C Langmuir Prize at the Buffalo meeting of the American Chemical Society on September 2 The Langmuir Prize, awarded for the first time this year, is bestowed "in recognition of the accomplishment, in America, of outstanding chemical research by a young man or woman preferably working in a college or university" It emphasizes, according to the announcement, the debt industry owes to pure science. Dr. L. V. Redman, vice-president of the Bakelite Corporation, Bloomfield, New Jersey, and president-elect of the American Chemical Society, was chairman of the jury of award, other members of which were. Professors Roger Adams, University of Illinois, S. C. Lind, University of Minnesota, Farrington Daniels, University of Wisconsin; Charles D Hurd, Northwestern University, Arthur E Hill, New York University, and Hobart H Willard, University of Michigan.

Mr. Frank J. Tone, president of the Carborundum Company, Niagara Falls, has been awarded the Jacob F. Schoellkopf gold medal of the western New York section of the American Chemical Society The award is made for a major advance in science embodying the spirit of research in industry. The medal will be formally presented at Buffalo, September 2, at the eighty-second meeting of the American Chemical Society by its president, Professor Moses Gomberg, of the University of Michigan, following the annual presidential address. Mr. Tone will deliver an address after the presentation on "The High Temperature Products of Silicon"

Mr. Henry Allen Moe, secretary of the John Simon Guggenheim Memorial Foundation, has announced the names of additional members on the advisory board of the foundation They include Dr. Thomas Barbour, professor of zoology and director of the Museum of Comparative Zoology, Harvard University, and Dr Florence R Sabine, member of the Rockefeller Institute for Medical Research

Dr. W E Tottingham, of the University of Wisconsin, was elected president of the American Society of Plant Physiologists and Dr R. B Harvey, of the University of Minnesota, was elected vice-president in the recent election Dr M A. Gardner will continue as secretary for another year

Dr. Thurlow C Nelson, professor of zoology at Rutgers University, has been elected president of the National Shell Fisheries Association at the convention of that organization and the Oyster Growers' and Dealers' Association of North America, Inc. He succeeds Mr. Lewis Radcliffe, of Washington, D. C. Other officers elected were Dr. R. V Truitt, of the University of Maryland, *vice-president;* Dr Herbert F. Prytherch, of Washington, D C, *secretary,* and Howard W. Beach, of New Haven, *treasurer*

Dr. William Gerry Morgan, past-president of the American Medical Association, has accepted the position of dean of the School of Medicine at Georgetown University. He will continue to serve as regent of the university

Dr. Thomas Freeman Cope has been promoted from assistant professor to professor of mathematics at Marietta College.

Mr. Earl Church has been promoted from assistant professor of mathematics to associate professor of photogrammetry at Syracuse University.

Mr. Herbert Hoover, Jr., son of the President of the United States, has been appointed assistant professor of business economics and radio engineering at the California Institute of Technology.

MR. F. B. ISELY, dean and professor of biology at the Texas Woman's College, has been appointed professor of biology at Trinity University, Waxahachie, Texas.

DR. ROBERT E LANDON has resigned from the U. S. Geological Survey and has accepted a teaching position in the department of geology at Colorado College, Colorado Springs.

MR. DAVID KEILIN, F.R S, of Magdalene College, has been elected Quick professor of biology at the University of Cambridge, succeeding Dr G H F Nuttall, who has held the chair since it was founded in 1906.

DR. G L. KELLEY, of Harvard University, has been appointed to supervise the research work in the manufacture of pressed steel coaches of the Pressed Steel Company of Great Britain

DR. ROBERT A. MILLIKAN, director of the Norman Bridge Laboratory of Physics and chairman of the executive council of the California Institute of Technology, is on his way to Europe. He goes to Germany as exchange fellow of the Oberlaender Trust of the Schurz Memorial Foundation, and in England will represent the National Academy of Sciences, of which he is foreign secretary, at the centenary meeting of the British Association and the Faraday and Maxwell celebrations.

DR. L. O. HOWARD, who recently retired after more than fifty years' service in the U S Bureau of Entomology, having been chief of the bureau from 1894 to 1927, is about to leave Honolulu for France, stopping on the way at several places of entomological interest. It is his intention to remain in France for at least a year.

DR. R. S. BASSLER, of the U S. National Museum, is spending two months in museum and field-work in England, Austria and Hungary His work primarily will be devoted to obtaining material for the increase of the Frank Springer collection of fossil echinoderms. In connection with this work he intends also to secure collections of Post-Paleozoic fossils from the Vienna basin and the Hungarian plain much needed for the museum

DR. W. REID BLAIR, director of the New York Zoological Park, has sailed to Europe to spend about seven weeks in connection with the plans made for a cattle group to be established at the park.

PROFESSOR FRANK C. BAKER, curator of the Museum of Natural History, University of Illinois, is spending the summer in a molluscan survey of Illinois, particular attention to be given the land species. Two seasons are planned in the field following which a manual of the land mollusca of the state will be prepared. Mr. Dale Foster, a graduate student of the department of zoology of the University of Illinois, will assist Professor Baker.

A FIVE months' leave of absence has been granted to Dr. L. O Overholts, of the department of botany at the Pennsylvania State College, to initiate a special research for the federal government. Dr. Overholts will spend several months in the forests of Louisiana studying timber diseases, and later go to Washington to classify and tabulate the findings.

PROFESSOR H. L. BOLLEY, dean of biology of the North Dakota Agricultural College, botanist and plant pathologist at North Dakota Experiment Station, who was granted leave of absence from the institution in July, 1930, for the purpose of making botanical and agronomic studies in Argentina and other of the more temperate regions of South America, has returned to the North Dakota Agricultural College and has brought back with him a number of specially selected seeds, particularly from the flax crop in Argentina and Uruguay. Professor Bolley was particularly interested in the methods of cropping pursued in the Argentine cereal cropping zones and paid special attention to the relationship of their methods of cropping as affecting the presence of diseases of the cereals and small grain crops, particularly of flax

DR. T WAYLAND VAUGHAN, of the Scripps Institution of Oceanography of the University of California, in cooperation with Mr M L. Maitland, of Long Beach, is aiding in the mapping out of a program of investigations to be undertaken this summer. Mr. Maitland has for several years been making a comparative study of recent and fossil foraminifera. They are planning the dredging of approximately 200 samples of sea bottom from shallow to deep waters between Long Beach and Catalina Island. A special fund has been given by the National Research Council for this work.

THE New England Intercollegiate Geological Excursion will take place this year in Montreal at the invitation of the department of geology of McGill University. The meetings will be held on Saturday, Sunday and Monday, October 10, 11 and 12. On Saturday members of the party will study the geology of Mount Royal and St. Helen's Island. On Sunday there will be two excursions, the first to study the stratigraphy of the neighborhood of Montreal, and the second to the Precambrian of the Laurentians, and on Monday structure and stratigraphy of the Appalachian front in Southern Quebec. Full details will be sent to members later Others wishing further information may write to T H Clark, department of geology, McGill University, Montreal, Quebec.

THE International Illumination Congress will be held in Great Britain from September 1 to 19 Provision is made for visits to London, Glasgow, Edinburgh, Sheffield, Buxton and Birmingham, following which the sessions of the International Commission on Illumination will be held at Cambridge Throughout the visits to the cities named, the technical sessions, at which more than a hundred papers will be presented, will alternate with trips and social events

THE next International Congress of Mathematics will be held at Zurich from September 4 to 12, 1932

THE sixth Natural Science Congress of the Dutch Indies will be held at Bandung, Java, from September 22 to 26 The congress will meet in six sections

THE Italian Anatomical Society will hold its third congress at Palermo in October The topics on the program are. morphogenesis of derivatives from the intestine, with an official paper by Professor Bruni, of the University of Parma, and new data on the histochemistry, morphology and histophysiology of cellular lipoids, with an official paper by Professor Ciaccio, of Messina. Professor Luna, of the University of Palermo, will be secretary of the congress

THE French-American Committee of the Curie Institute, Paris, according to the Paris correspondent of the *Journal* of the American Medical Association, has been organizing receptions in honor of the nations of the Americas Twenty-two countries were represented The first reception was held at the Radium City, which was erected with the aid of subscriptions in which these countries participated The receptions were attended by diplomats, savants, industrialists, literary men and artists Professor Regaud, director of the institute, and Madame Curie and daughter were the host and hostesses, respectively, in the department for the technical study of radioactivity and the cancer department Madame Curie gave a lecture on radium and exhibited to the visitors the tube, preserved in a glass case, that contains the first particles of radium secured by her husband and herself.

MORE than 100 official delegates, representing 30 countries, and more than 400 other participants attended the fifteenth International Congress of Agriculture in Prague, Czechoslovakia, which was held from June 5 to 8 Mr. Asher Hobson, in charge of the Foreign Agricultural Service, U S Bureau of Agricultural Economics, was an official delegate to the congress, and has recently returned from abroad The congress this year was divided into seven sections, dealing with agrarian policy and rural economy, agricultural teaching and extension, agricultural cooperation, plant production, animal production, agricultural industries and rural women. Mr. Hobson was one of the three principal reporters for the section on agrarian policy and rural economy. The discussion at the congress centered on the world wheat crisis, with special reference to preferential treatment to grain from eastern European countries by western European countries The export quota system also received attention The congress did not commit itself definitely on either of these subjects

MESSRS BAILLIERE, TINDALL and COX are publishing shortly for the Bentham Trustees the "International Address Book of Botanists" which has resulted from the resolution of the fifth International Botanical Congress of 1930 This will be on lines somewhat similar to Dorfler's "Botaniker Adressebuch," and will contain the names of some 13,000 to 14,000 botanists and botanical institutions, etc., in all parts of the world These will be arranged alphabetically by countries, will be printed in the majority of cases in the language of the country in Roman script and will be provided with an index of personal entries and geographical indices In the publication of the book the International Committee has received assistance from the Bentham Trustees and from the Carnegie Corporation of New York

IT is reported in the daily press that the island of St. Kilda which lies off the Hebrides on the northwest coast of Scotland, and which was evacuated by its few remaining inhabitants last year, has now been bought as a bird sanctuary It has always been the resort of countless seabirds and is well suited for the purpose The island has belonged to the Highland chieftain Macleod of Macleod for over 300 years

THE annual reports for 1930 of the British Museum, Bloomsbury, and the Natural History Museum, South Kensington, were issued recently. The summary in the London *Times* states that visitors to the British Museum increased during the year to a total of 1,201,639, as compared with 1,191,758 in 1929, and 1,181,617 in 1928. This increase was entirely due to a rise in the number of Sunday visitors, the week-day numbers having decreased by 412. The total number of students who visited particular departments also rose by 13,186 to the highest total yet recorded, 285,538. This increase was chiefly found in the reading room and manuscript room The number of art students visiting the sculpture galleries fell from 1,671 to 659, the lowest recorded in recent years. Attendances at the Natural History Museum fell from 541,198 in 1929 to 506,407 in 1930. The scientific staff of the museum was increased by 15 and the subordinate staff by 24. Economic advice was given by the Department of Zoology on the protection and control of elephants in Africa, the control of the musk-rat, occurrences of parasitic worms in man and animals in Nyasaland, Morocco, Algiers, the Sudan and East Africa; and the ravages of shipworm at Haifa and Rangoon In the entomological department work was done in relation to insects causing or transmitting disease, pests of stored products, boring insects and farm and garden pests

The Illinois State Department of Health at Springfield has issued a statement in which it is noted that the circumstance that fatalities from diarrhea and enteritis jumped from 1,306 in 1929 to 1,531 in 1930, a very significant reversal in the recent trend of mortality from these causes It is pointed out that fatal intestinal infections, especially in children, nearly always reflect errors in diet Either the food is not wholesome or the wrong kinds of foods are consumed Economic distress has doubtless led many families to modify radically their food supplies Frequently, this has cut out from the diet of children, or reduced beyond the point of safety, such indispensable foods as milk and eggs No medicinal or specially prepared vitamin products can take the place of milk and eggs in the food supply of children Over 90 per cent of the mortality from diarrhea and enteritis occurs among children under 2 years old A sharp decline in milk and egg sales during 1930, as compared with 1929, indicates that the difficulty is associated closely with the economic situation From a health standpoint, the statement says, it appears that a serious disturbance of the family food supply should be the last matter affected by a retrenchment program Wisely expended, a very small *per capita* outlay will provide a well-balanced diet at prevailing food prices.

The Hungarian correspondent of the *Journal* of the American Medical Association reports that Count Kuno Klebelsberg, Hungarian minister of public instruction, recently announced in the National Assembly that the American Rockefeller Foundation had entered into cooperation with the University of Sciences in Szeged and the Biological Research Institute in Tihany, and had granted 1,018,000 pengo for the two institutes According to the accepted plan the Szeged University will devote from this sum 678,300 pengo to the equipment of natural history and theoretical medical scientific institutes, and to cover the current expenses of scientific investigations the foundation allows 200,000 pengo, about $40,000 For the erection of a glasshouse at the biological institute in Tihany, on the bank of the Danube, the foundation allowed 70,000 pengo, and for covering the current expenses of the next five years it gave 50,000 pengö. During this period also the Hungarian state will contribute a large sum to the budgets of these institutions. The correspondent of the *Journal* writes. "The Hungarian public received this report with immense enthusiasm, not only is the princely sum which was donated appreciated, but still more so the moral achievement. The foremost and richest scientific institution of the world gave a helping hand to two Hungarian scientific institutions from which they obviously expect results on behalf of the entire human family. With this act the Rockefeller Foundation not only obliged the Hungarian state and community, but it made a great service also to the universal natural sciences and to the search for truth The minister, when expressing gratitude at the sitting of the National Assembly, spoke, in fact, from the heart of the whole Hungarian nation"

Erratum In the issue of Science for August 14, on page 171, the bequest of Dr Richard Alexander Fullerton Penrose, Jr, was incorrectly stated owing to a line having been misplaced after the pages had been made up The residue of Dr Penrose's estate, valued at $1,000,000, is divided equally between the American Philosophical Society and the Geological Society of America.

DISCUSSION

WHY THE ANGIOSPERMS ARE OLD

A consistent course of leaf change from Carboniferous times down, easily leading into trident (Sassafras), bladed (Magnolia), and other angiospermous leaf types through a gradually developed net venation, or especially through invasion of a marginal net, has been outlined with reference to type fossils elsewhere. It is believed this view of a wide-spread and gradual development of the foliar features of modern forest types taken in general is a valid one, though unlikely to at once appeal to those unfamiliar with the manner in which fossil leaf evidence bulks up in the field. No less, there should be some further recourse of proof. Does not such come into view when the classification of vascular plants is enough simplified?

Now in the first instance (as indicated by Jeffrey), all stem structures fall into two great series or lists, the lycopsida and the pteropsida. From the former might be separated the sphenopsida. Be this as it may, what is held here is that neither the sphenopsids nor the lycopsids include true floral antecedents, and that fructification in the lycopods and in selaginella is non-zonate and therefore has never had anything to do with the origin of the cones of conifers or the flowers of angiosperms, while in the second instance the pteropsida include the great lines of seed plants, probably all going back beyond the Carboniferous as follows

ARCHAEOSTROBILE (The protospermatophyta, primitively amphisporangiate)	I *Metastrobile* (inflorescent)	Cordaites Ginkgos Conifers
	II *Anthostrobile* (floral)	Gnetales Angiosperms Cycadeoids
	III *Neostrobile* (carpellary)	Cycads Lyginopterans Medullosans

This scheme portrays a unit view of cone, or of primitive strobilar and floral structure It could be called the view or theory of *monomorphy.* It suggests, if it does not even emphasize conformity in a course of variation which throughout all the lines of seed plants extends back to, and takes its beginnings in amphisporangiate primitives just above the algae. That for instance searching anatomical study of angiospermous floral structures does not confirm the claim for the presence of "polymorphy" or complexity in emplacement of floral parts (*Cf* Eames), is a strong supporting point That the cycadeoid floral origin and history runs parallel to that of the angiosperms must also be believed The primitive form would alike be a zonate and amphisporangiate spiral. It need not be supposed that in this the gnetaleans varied Nor is it likely that the cones of conifers had an entirely separate origin

That the Cordaites are not better known is perhaps the greatest tragedy of present-day fossil botany. Evidently much more will be learned about this exceedingly varied group It seems at present to be a fundamentally inflorescent group with the male flowers and the female very much alike if the stamens may be considered analogous to carpels and those of course to modified leaves The group is evidently dioecious or monoecious Could it have been derived from an amphisporangiate ancestry which through branching developed the reproductive axis of limited growth and then monoecism? With regard to the dioecious Ginkgo, except for advance in wood structure the features are Cordaitean, while if the stalk bearing the two ovules is an axillary shoot as seems likely, a cone homology with the cycads also exists. As to the conifers, they are now and have long been a homogeneous group, the most specialized of all gymnosperms Did they ever include, or were they derived from a primitive amphisporangiate type which after branching became monoecious, then partly dioecious? Such might be defined as a hemiconifer. In conifers the stamens are still simple; but the seed scales are axillary and utterly modified Hence it is not so sure that the basal and zonate spirals of stamens in abnormal amphisporangiate axes have no reminiscent meaning

Turning again to Group II of the scheme it is noted that in view of the pine-like character of the *Gnetum* wood, and the fact that the amphisporangiate flower of *Welwitschia mirabilis* may even be primitive for all Gnetaleans, the question whether such floral unit was in some like manner antecedent in pines and Cordaites can not be called absurd. In any case an extreme antiquity is suggested for all of these types and groups. Unfortunately amongst the cycadeoids where it might most be hoped to answer questions of antiquity, evidence still fails Notwithstanding the certainty of a long and cosmopolitan history the flowers are not seen beyond the Triassic, by which time despite a general simplicity of structure, modernity of type and form had already been reached. The supposed affinities with the cycads and seed ferns afford little aid in picturing the antecedent forms Though, however the cognate facts and inferences may all fall, can the angiosperms in turn have had any other than a very remote and always amphisporangiate ancestry? It is held not. Only polyphyly explains.

In Group III the cycads could at least be derivatives of monoecious forms, while the sporophylls are of course analogous to stamens and carpels in angiosperms The difficulty of deriving the angiosperms from within this complex, at least as homogeneous as either of the preceding, rests in the absolute lack of evidence for the presence within it of amphisporangiate axes of limited growth. The numbers are now few, giantism is intense, and apparently fertile recessiveness in the cones never occurs Nor is much of suggestion here afforded by the seed ferns because their microphyllous variants and antecedents are not seen, and are as difficult to picture as any other hypothetic types. The medullosans are really the aberrant pteridosperms on which aside from the isolated and odd Caytonia must rest the first possibility of angiosperm affinity. Their mimicry of monocot stems was long overlooked. The tracheids are of a form which could easily give rise to vessels. The branching is peculiar.

The great evolutionary fact is that whereas in dicots and cycadeoids stem branching supports the reproductive axis of limited growth, free branching in monocots is confined to the flowering shoots. The shoots have a remote analogy to inflorescent cones. The simple cone (as seen in cycads), the flower, the inflorescent cone or strobilus of conifers, [illegible] branching of dicots and conifers, and the reproductive

tive branching of the endogenous and columnar monocot, mark out the great ways of higher seed plant evolution And when these ways are followed back with due attention to the most logical grouping of the seed plants and the fossil record, it is seen that flowers must go so far back that it is reasonable to hypothesize archaic forms above the algae leading into plants little else than a stalk bearing a few leaves followed above by micro- and then megasporophylls. According to such conceptions, in the subsequent course of phytologic evolution foliage leaf advance often tended to be thrown back into the megasporophyll, while flowers always tended to remain small, cones always to reach giantism Whence as in the above classification, it seems reasonable to consider the flowering types as the older line and to place them between the simple cone types (cycads) on the one hand and the inflorescent strobilar types (conifers) on the other.

In looking over present day plants, and back through time, nothing is so deceptive as megaphylly and giantism, unless perhaps the mixed cones of selaginella and those of lepidodendron. It is too much to expect directly from fossils the fuller history of flower and cone. The sporophyll, cataphyll and stipules, the rôle of branching, of monoecism and dioecism, must all be considered *per se* Only through analysis aided by diagram is it seen that the flower has always been just an emplacement of sporophylls at first spiral, then whorled and cyclic And then only does unity in the classification—accord in structure and origin begin to appear.

Moreover, botanists have not sufficiently emphasized the fundamentally significant fact that precisely the forms concerned in plant descent throughout the ages, therefore the relatively extinct forms, should not be expected to occur as left-overs in surviving floras. Mainly the specialized types, or those of peculiar environments are the ones seen as fossils The assumption that the visible fossil antecedents are numerous is an utter fallacy. It too easily leads to the thought that the dint of a hard analysis and approach to the problems of seed plant origin from every possible view-point may be escaped.

G. R. WIELAND

CARNEGIE INSTITUTION

THE OCCURRENCE OF PHYLLOERYTHRIN IN THE DIGESTIVE SYSTEM OF HERBIVOROUS ANIMALS

IN 1903 Marchlewski[1] described a compound obtained from the fresh excrement of a cow fed entirely on grass and gave to this compound the name of phylloerythrin. In the same year Loebisch and Fischler[2] isolated bilipurpurin from ox-bile. Marchlewski later showed that bilipurpurin and phylloerythrin were identical compounds and that they were the decomposition products of chlorophyll formed by the herbivorous animal. H Fischer and O Süs[3] used phaeophorbide *a* to prepare phaeoporphyrin a_6 and a_5 and from these compounds they succeeded in preparing phylloerythrin, thus proving chemically that phylloerythrin originates from chlorophyll[4]

The presence of such a chlorophyllous product as phylloerythrin in the bile and the feces of herbivorous animals is of considerable interest, and since, in so far as we are aware, no one has determined the place or mode of origin of this substance in the body, the present work was undertaken with these objects in view.

We have demonstrated that phylloerythrin occurs in the third stomach (omasum) of cows and sheep which were fed on a normal winter diet containing chlorophyll. The stomach contents were collected at the slaughter house about fifteen minutes after the animals were killed and the material taken to the laboratory and extracted with a chloroform-pyridine mixture. An ether solution of the extracted pigments was fractionated with hydrochloric acid and the eight to nine per cent fraction gave an absorption spectrum in pyridine-ether identical with phylloerythrin. This latter substance was crystallized from pyridine-alcohol. At the present time a sufficient quantity for a combustion analysis has not been obtained, but this will be done later Using the same procedure as that used for the third stomach, we demonstrated spectroscopically that traces of phylloerythrin occur in the first stomach (rumen) of the cow and the sheep. The third stomach contents of a calf on a milk diet gave no trace of phylloerythrin.

Further work on the physiological formation of phylloerythrin outside the animal body is now in progress. The experimental details and a complete summary of the literature pertaining to this work will be published elsewhere a little later.

O L. INMAN
PAUL ROTHEMUND

C. F. KETTERING FOUNDATION FOR
THE STUDY OF CHLOROPHYLL AND
PHOTOSYNTHESIS, ANTIOCH COLLEGE

---

[1] *Bull. int. de L'Académie Polonaise des Sciences et des Lettres*, Série A, p. 638–642, 1903.

[2] *Monatsch. f. Chemie*, pp 335–350, 1903.

[3] Ann. vol. 482, p. 225–232, 1930.

[4] H. Fischer, O Moldenhauer and O Süs, Ann. 486: 107–177, 1931, have shown that phaeoporphyrin a_5 and a_6 are identical.

FRESH WATER MEDUSAE IN OKLAHOMA

The finding of *Craspedacusta ryderi*[1] in an Oklahoma stream seems to be of sufficient general interest to warrant this note All other records of this interesting form are from localities east of the Mississippi River [2,3,4,5]

On September 6, 1930, Phillips first noticed the medusae in Lukfata Creek, a tributary of Little River, about one quarter mile north of Broken Bow, Oklahoma (Sect 27 or 34, T6S–R 24E) Individuals were also seen in Yanubee Creek in Sect 17, T6S–R 25E. Individuals were at first very numerous and were seen and collected at intervals during the three weeks following their discovery The number was so great that "the water was almost blue with them"

We are indebted to Mr Glen R Durrell, district forester, and Mr W H Mitchell, assistant district forester, for properly shipping us the specimens

The part of Lukfata Creek where these medusae were taken was a relatively clear pool approximately 200 feet by 25 feet The depth averaged 4 to 5 feet The stream is known to have been "scoured out" this spring by floods, since that time the water has remained low The specimens were found in water at least three feet deep near the center of the pool The temperature of the water at that time was between 70° and 75° F

The activity of the medusae consisted of slow movements in a vertical direction The upward excursion resulted from repeated contractions of the umbrella The return to the bottom of the pool was brought about by one of two methods, first, by "side slipping," and second, by turning over completely and propelling themselves downward This cycle was completed about twice in a minute They did not become active until the sun was fairly well up [6]

No hydroid has been found as yet, but it is hoped that additional work next year may reveal this stage

A I Ortenburger
George R Phillips

University of Oklahoma and
Oklahoma Forest Commission

---

[1] The authors wish to thank Dr F Payne for checking their tentative identification of these specimens.

[2] C W Hargitt, Science, 26: 638, 1907.

[3] H. Garman, Science, 44. 858, 1916

[4] F. Payne, *Jour. Morph*, 38· 387, 1924, *Biol. Bull*, 50· 433, 1926

[5] W E. White, *Biol. Bull*, 59. 222, 1930.

[6] H. Garman, Science, 60. 477, 1924.

THE "FIRE STOPPER"

Recent papers in Science[1] discussing the use of the divining rod recall to my mind a conversation which took place in my presence, a few years ago, on a topic which was new to me. Nor have I since seen or heard any reference to this subject. The speakers were descendants of the German racial group frequently spoken of as "Pennsylvania Dutch," whose ancestors had migrated to the southwest

Night had come to the road camp astraddle the Virginia-West Virginia boundary. The bee tree had been cut, the honey secured and the men were drifting back to camp Among the first was old Paul Straus. He did not like these expeditions He complained that a bee would fly a hundred yards to attack him no matter how many men there were closer to the bee tree But at this safe distance in the darkness he became reminiscent.

"Old Jo Kirschbaum," he said, "could go right up to any tree They never bothered him I've seen the bees just buzzing all around his head—yellow jackets, too He used to say you'd be all right as long as you didn't do anything to make them cross"

"Who was that, Mattie's father?" asked Homer Heatwole

"No, Sam's uncle, old Oscar's brother"

"Oh, yes, I remember now He could stop fire, too, couldn't he?"

"Yes, he'd just walk through the woods where there was fire coming, and when the fire got up to where he'd been walking it would just stop burning I wish I knew how he did it I gave him five dollars once to teach me how and he said he would some time, but he never got around to it Always busy with something else he couldn't leave He's gone now He told me once if he taught it to anybody else he'd lose the power himself"

"Were you down at that fire on the Hunter land that he stopped?" asked Homer

"No, but I saw the place afterwards"

"So did I. There was one place there where there were dry pine tops piled up and he walked across them and the fire stopped right there in the middle of the pile."

"Yes, I remember seeing that, too. Old Jo certainly had the power There are not many that have."

The rest of the crew were coming in now with the lanterns and honey and the conversation turned to the subject of past and future bee tree hunts and present drinking water. The discussion was not resumed either then or later.

I wonder whether other readers of Science have ever come in contact with persons holding this belief There is of course the possibility that we are dealing with an imaginative story of the type of the "Paul

---

[1] C. A. Browne, ''Observations upon the Use of the Divining Rod in Germany,'' Science, 73: 84–86, 1931. I. P. Tolmacheff, ''The Use of the Divining Rod in Alaska,'' Science, 73. 365–366, 1931.

Bunyan" yarns. But my observations of those men at other times would indicate that they were not given to this type of exaggeration Apparently they were sincere in their belief that the incidents actually took place. And if they were, the question remains to be answered What was the basis of this belief?

FERDINAND W HAASIS
CARNEGIE INSTITUTION OF WASHINGTON

SPECIAL CORRESPONDENCE

INTERNATIONAL PHYSIOLOGICAL CONGRESS FUND FELLOWSHIPS

AT the annual meeting of the Federation of American Societies for Experimental Biology in Chicago in 1930, the American Committee for the Thirteenth International Physiological Congress presented to the federation the surplus funds collected for the congress and in accordance with the suggestions of the committee, the International Physiological Congress Fund was established by the federation The action was as follows

"The income of the International Physiological Congress Fund shall be used triennially for the appropriation of funds in units of $250 to defray the expenses to international physiological congresses abroad of promising young workers in the field who would not otherwise be able to attend the congress, who shall have creditable papers to read before the congress, whose ages shall be below 35 years, and who shall not yet have attained the rank of full professor These fellowships are to be allotted by the executive committee of the federation

"Furthermore, within the judgment of the same executive committee it may be permissible to grant to any candidate an additional sum of $250 provided such candidate desires to spend three months of study in a foreign laboratory Generally speaking, the executive committee should be guided in the selection of individuals with due regard to the relative numbers of the present membership in the four different societies which constitute the federation By unanimous vote of the executive committee the rules may be changed at any time governing the amounts of money to be granted to any individual

"It is furthermore suggested that if and when another international physiological congress shall be held in the United States the principal of this fund shall be turned over to the authorities duly appointed by the officers of the federation to receive it and shall be used for the promotion and support of that international congress"

There will be available for the Fourteenth International Congress to be held in Rome from August 29 to September 3, 1932, four International Physiological Congress Fund Fellowships of $250 each One fellowship will be awarded in each of the branches of biological science represented by the four constituent societies of the federation · namely, The American Physiological Society, The American Society of Biological Chemists, The American Society for Pharmacology and Experimental Therapeutics, and The American Society for Experimental Pathology

The conditions for the award of these fellowships, in accordance with the vote of the executive committee of the federation at their Montreal meeting in April, 1931, were fixed as follows

(1) Each candidate must be recommended as worthy by some member of the society representing the field of study or by some other individual familiar with the character of the candidate's work

(2) Candidates must be under thirty-five years of age and must not have yet attained the rank of full professor or its equivalent

(3) Each candidate must present with the application a draft of a meritorious paper to be presented to the congress

(4) Applications must be made before *January 1, 1932,* to the *secretary* of the society which includes the field of study

(5) These applications are to be considered by the councils of the respective societies, who shall submit to the executive committee of the federation an approved list of nominees

(6) Final selection of fellows shall be made by the executive committee of the federation

It was the consensus of opinion that fellowships should be awarded only to those persons having meritorious work to present to the congress and who would be unable to attend the congress without some financial assistance in the form of a fellowship or other subsidy It should be noted that membership in the federation is not necessarily a condition for the award of a fellowship

Applications should be made to the secretary of the society in whose field the work to be presented at the congress lies for Physiology, Dr Arno B Luckhardt, University of Chicago, Chicago, Illinois, for Biological Chemistry, Dr Howard B Lewis, University of Michigan Medical School, Ann Arbor, Michigan; for Pharmacology and Experimental Therapeutics, Dr V E Henderson, Medical Building, University of Toronto, Toronto, Canada; for Experimental Pathology, Dr C Philip Miller, Jr., Department of Medicine, University of Chicago, Chicago, Illinois.

HOWARD B LEWIS, *Secretary*
Federation of American Societies for Experimental Biology

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLIFIED INSTRUMENTAL METHOD OF MEASURING SOUND ABSORPTION COEFFICIENTS

Since the foundation of the science of architectural acoustics by the late Professor W S Sabine,[1] of Harvard, many instrumental methods have been devised to take the place of the ear-reverberation method described by Sabine Among these instrumental devices are those of Chrisler and Snyder,[2] Wente and Bedell[3] and others

While most of these instrumental schemes have been quite successful in reducing the measurements to purely objective values, thus eliminating the ear as a source of possible error, yet in most cases the instruments themselves are quite complex and they are not easily assembled from apparatus usually found in physics laboratories For this reason an effort was made in the present case to devise an apparatus which would be simple, easily assembled and yet reliable

The usual procedure in instrumental practice as regards sound absorption measurements in reverberation rooms is to make use of the sound decay formula, as developed by Jáger,[4] which, when modified to make it applicable to instrumental methods, is as follows

$$A_1S_1 = \frac{4\,V \times 2\;3 \log_{10}\left(\frac{E_1}{E_2}\right)}{C\,(t_2 - t_1)} \qquad (1)$$

where A_1 is the average coefficient of absorption of the walls, ceiling and floor of the empty reverberation room,

S_1, the area exposed to sound
V, the volume of the room
C, the velocity of sound at the temperature of the room
E_1, a certain sound energy level intensity
E_2, a subsequent sound energy level intensity
t_1, a time in seconds corresponding to E_1
t_2, a time in seconds corresponding to E_2

When absorbing material is added to the room, equation (1) becomes

$$A_1S_1 + A_2S_2 = \frac{4\,V \times 2\;3 \log\left(\frac{E_1}{E_2}\right)}{C\,(t_2 - t_1)} \qquad (2)$$

where A_2 and S_2 are the coefficient of absorption and the area of the material respectively. It is thus obvious that if we have some method of determining E, the sound energy level in the room at any given time, t, it is possible to evaluate A from a curve obtained by plotting values of $\log_{10}E$ against corresponding values of t.

The method being used at Indiana University is essentially as follows.

Sound is produced in a reverberation room by blowing a metal organ pipe of standard make with compressed air at constant pressure as measured by a manometer After the sound has been maintained for a time, considerably longer than the reverberation time of the room, the air is suddenly cut off and a sound decay curve is made from points determined by the recording apparatus herein described.

The recording apparatus consists of a Jenkins and Adair condenser microphone,[5] the output of which is amplified by a four stage transformer coupled A C. amplifier as illustrated in the accompanying diagram, Fig 1 The output of this amplifier is fed through a volume control potentiometer into a step-down current transformer from which it passes to a thermocouple galvanometer,[6] which reads directly in arbitrary energy units. The observer and all the recording apparatus except the microphone is in a room adjoining the reverberation room.

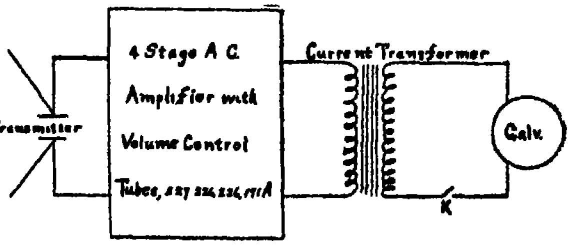


FIG. 1. Diagram of recording apparatus.

In making a determination of sound absorption, a metronome is set vibrating with a certain period. In coincidence with a given click of the metronome the air is cut off by a valve At some subsequent click (say the second or third), the key K, is closed, which results in a deflection of the galvanometer. The process is repeated for other settings of the metronome, and of course several readings are taken for each setting, to insure a conservative average. If, now, the apparatus is calibrated to read in decibels of decay and the output volume control is set accordingly, it is immediately apparent that the values for coefficient of absorption may be calculated from the slope of the curves obtained by plotting values of $\log_{10}E$ against corresponding values of t.

---

[1] W. S. Sabine, Collected Papers Harvard Press, 1922

[2] Chrisler and Snyder, *Bur. Stand Jour. Research*, Vol 5, Oct., 1930

[3] Wente and Bedell, *Jour Acous Soc Amer*, 1: 422, April, 1930.

[4] C. Jäger, *Wiener Sits Ber*, Vol. CXX, 2a, p. 613, 1911

[5] Note:—An ordinary double button microphone may be substituted for the condenser type thus eliminating special batteries. The outfit then becomes all A.C. and quite portable.

[6] The current transformer and thermo-couple galvanometer are of commercial type and may be secured at nominal cost.

Fig 2 is a set of curves plotted from data taken as indicated These curves show the logarithmic nature of the decay quite as well as similar curves obtained by more complicated recording devices The values for absorption coefficients obtained in this manner have been checked against values for the same kinds of materials found by observers in other laboratories and against values found by the ear method in another room at Indiana University and the agreement is very good.

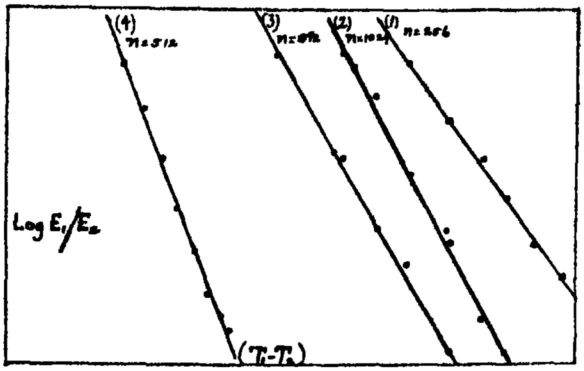


Fig 2 Decay curves (1), (2) and (3) Empty room values (4). Room treated with 30 square feet of material.

It will be noted that a coincidence determination is substituted for a duration of time measurement in the older method. It is of course obvious that coincidence determinations are capable of a very high degree of accuracy, a conclusion which is borne out by the fact that the points thus determined fall so nearly exactly on a logarithmic decay curve

It was intended at first to make an automatic device to cut off the air, and at some subsequent time to close the key, but measurements made in the manner described seem to indicate that little or no improvement would thus be afforded, probably not enough to warrant the added complication.

The apparatus was devised as a means of carrying out a research problem in architectural acoustics which is now in progress under the direction of Professor Arthur L. Foley. The writer wishes to acknowledge his counsel in the matter, and also the many suggestions offered by Professor R. R. Ramsey, of the physics department.

James F. Mackell

Department of Physics,
Indiana University

A NEW DEHYDRATING AGENT FOR HISTOLOGICAL TECHNIQUE

Recognizing the usefulness of a substitute for ethyl alcohol to be used as a dehydrating agent in histological technique, the writer experimented with isopropyl alcohol over a period of 18 months. Isopropyl alcohol, 98 to 99 per cent, may be obtained for about $2 85 per gallon. This percentage may be used directly as absolute alcohol if necessary. It may be made completely absolute by distillation from rock lime.

In the experiments pieces of animal tissues were treated in the usual way (merely substituting isopropyl for ethyl alcohol) Permanent slides made by the paraffin method were set aside for several months and were found to be perfectly good when examined. Later a piece of earthworm which had remained in a paraffin block for a year was sectioned and excellent slides were obtained. In the meantime a class of 38 men with no previous experience in histological technique was given isopropyl alcohol to use. These men made slides of Opalina, changing the grades of alcohol and xylol by pipetting the various solutions from small vials containing the Opalina They also made whole mounts of trematodes, etc., using either cedar oil or xylol after the alcohol. Finally each man made serial sections of tapeworm proglottids. In every case the technique following the use of isopropyl alcohol was more successful than the technique of previous classes which had used ethyl alcohol.

From the various experiments made, the writer proved that not only is isopropyl alcohol as good a dehydrating agent for animal tissues as ethyl alcohol, but in addition that its use affords important advantages. It does not harden animal tissues as much as ethyl alcohol. Consequently whole mounts of large objects are less likely to break up and tissues imbedded in paraffin seem to section with greater ease. Isopropyl alcohol may be obtained readily by any one since it is not intoxicating This fact should be of special interest to high-school teachers of biology. The only disadvantage is that it costs more than ethyl alcohol. This is compensated in part by the fact that isopropyl alcohol is less likely to disappear from the laboratory.

I suggest that some one interested in plant histology experiment with isopropyl alcohol to see if it is not superior to ethyl alcohol in respect to the extreme hardening effect of the latter upon certain plant tissues.

O. C. Bradbury

Wake Forest College,
Wake Forest, N. C

SPECIAL ARTICLES

ON THE RELATIVE STERILITY OF THE ADOLESCENT ORGANISM

THE literature of adolescence is chiefly psychological Anatomical and physiological studies on the adolescent organism are extremely sporadic and uncorrelated A recent conference of "experts" served chiefly to emphasize our ignorance of the subject

One of the prevailing notions concerning adolescence is that it is a very restricted period of time marked by sudden, almost explosive changes in bodily structure and function The immature organism is represented as becoming all at once mature, the boy becomes a man, the girl a woman, almost as if by a change of clothing The illusion is probably due to the popular as well as gynecological notion that the first menstruation, which certainly is a definitely demarcated event, is equivalent to the attainment of full maturity It can, however, easily be shown that puberty and maturity are neither synonymous nor synchronous The interval of time between the two in man, monkey and rat is about what one would expect with the application of Donaldson's law of equivalent ages three years, one year and one month, respectively, for man, monkey and rat

The Carnegie colony of rhesus monkeys has had fifteen females whose every menstrual cycle from the very first was observed An excellent opportunity was thus afforded for studying the phenomena of adolescence, as affecting body growth, certain changes in the secondary sex characters and changes in the ovaries and genital tract The sex skin becomes redder and redder and at the same time greatly swollen, almost to pathological proportions at times Such swellings are extremely rare in mature animals Furthermore, the menstrual cycles of the young females are extremely irregular in length and duration, and there is a very low incidence of ovulatory as compared with non-ovulatory cycles

Now, these fifteen females averaged 3,350 grams in weight at the first menses Most of them were mated soon after puberty, but not a single female conceived before attaining a weight of 4,370 grams The average weight at first conception of nine of these females was 5,000 grams, hence it is apparent that many menstrual cycles passed between the first menses and the first conception, despite frequent matings in the interval The interval may be estimated at about a year of time

The same gradual unfolding of maturity holds true for such good breeders as the rat and the mouse. Slonaker's studies on spontaneous activities in the rat[1] show a gradual increase in the peak of the cyclic activity to the maximum which is maintained during the reproductive life of the individual This "staircase" phenomenon of adolescence indicates a gradual though saltatory increase in the effect of the ovarian hormone It is very likely that the first cycles of moderately high activity were unaccompanied by ovulation, though I know of no studies on the rat to bear this out

With regard to the mouse we are somewhat more fortunate That puberty and maturity are distinct phenomena separated by a considerable interval of time was established for the mouse by Mirskaia and Crew[2] In a series of experiments pregnancy followed first matings in only 24 per cent of cases, whereas the same mice were 80 to 90 per cent fertile with later matings Puberty is defined by these authors as the ability to elaborate functional gametes and to possess the physical ability and the desire to play the appropriate rôle in mating, maturity, on the other hand, is defined as the stage of maximum fertility ratio and the ability to produce viable offspring and to rear them

In this definition, ovulation is included as one of the criteria of puberty To my notion maturity, the end of adolescence, is marked by the first ovulation and the preparation of a receptive uterus capable of carrying the offspring to term, puberty is indicated by the first manifestations of gonadal activity and marks the beginning of adolescence The threshold for the hormones causing the latter changes (sex color, menstruation, cyclic variations in spontaneous activity, cornification and opening of the vagina, according to various species are much lower than the changes culminating in ovulation and conception

The onset of menstruation in girls is, of course, a momentous event Nevertheless, though the mores of a given people may force "effective marriage" upon them at this moment, there is much indication that, by and large, nature herself prevents motherhood supervening during an important series of preparatory years

The reader will naturally recall the case of India in this connection and the lurid picture of child mothers conjured up by Katherine Mayo in her notorious "Mother India" This propagandist would have us believe "The Indian girl, in common practise, looks for motherhood nine months after reaching puberty, or anywhere between the ages of 14 and 8 The latter is extreme, though in some sections not exceptional, the former is well above the average."

In characteristic fashion, Mrs. Mayo fails to continue her quotation from the Appendix VII of the 1921 Indian Census, where we read that, though cohabitation begins with puberty, "in the majority of cases the first child is born the third year of effective marriage." Alden Clark[3] has pointed out, furthermore, that returns from maternity hospitals place the first parturition at 18.3 to 19.4 years. At the Madras Maternity Hospital only 10 out of 3,000 cases were under 15! Besides, we learn also from the 1921 census that only 309 out of 1,000 girls were married at 15, which would seem to indicate the average age at menarche is over 15 rather than under 13!

---

[1] *Am. Jour Physiol*, 1904, on

[2] Proc Roy. Soc, Edinburgh, 1930.

Among gynecologists Dr. Henry Vignes seems to be the only one to recognize the principle suggested in this paper. He says in his "Physiologie Gynécologique" (Paris, 1929), p. 55: "The onset of menstruation does not mean the capacity for conception; many girls who are just beginning to menstruate conceive with difficulty. Godin says that the age of maturity (nubilité), when the individual is capable of reproducing, is about five years after puberty." Dr. Vignes, moreover, kindly sent me a copy of the article "Nubilité" by Mondière in "Le Dictionnaire des Sciences Anthropologiques" (1890?). This gynecologist spent some years in Cochin-China, where he gathered certain data (first menses, first parturition, number of children, menopause, etc.) concerning 960 Annamite, 106 Chinese and 87 Cambodian women. He found that the first menstruation took place on the average at 16¼ years in the Annamites, at 16½ in the Chinese, at 16 10/12 in the Cambodians, the first parturition in these groups at 20½, 16 10/12 and 22½ years, respectively, despite their early marriages. He therefore concludes: "Maturity (nubilité) is often confused with puberty, which is a very different thing, for maturity signifies the faculty of normal reproduction."

This interval between the appearance of the first manifestations of sexual activity and the ability to conceive doubtless explains the Trobiand Islanders' ignorance and denial of physiological paternity and the corollary thereof, a matriarchal form of society, as set forth by Malinowsky in his "Sexual Life of Savages" (London and New York, 1929). Contact with white man has not yet made any headway in convincing the natives that sexual intercourse has any relation to procreation.

Malinowsky is, nevertheless, well-nigh baffled by the fact that despite the absolutely unrestrained and promiscuous sex life of the young Trobiander from childhood on, pregnancy among young unmarried girls is extremely rare—perhaps one per cent. "Can there be any physiological law," the author asks, "which makes conception less likely when women begin their sexual life young, lead it indefatigably, and mix their lovers freely?"

It seems highly reasonable that Malinowsky's predicament is explained by the facts presented in this paper, namely, that the first menstruation (*puberty*) marks merely an early manifestation of a train of events (*adolescence*) which only after three or four years on the average lead to ovulation and conception, the proof of *maturity*.

Carl G. Hartman

Carnegie Institution of Washington,
Baltimore

---

[3] *Atlantic Monthly*, February, 1928.

THE ETIOLOGY OF EPIZOOTIC ENCEPHALOMYELITIS OF HORSES IN THE SAN JOAQUIN VALLEY, 1930[1]

Early in July, 1930, scattered cases of a peculiar disease of horses which involved the central nervous system began to attract the attention of the livestock owners in certain parts of the San Joaquin Valley. A gradually increasing number of cases was reported from most sections of this region throughout the month of August. With the onset of cool nights the disease disappeared. The peak of the epizootic was reached in the middle of September; no cases were reported after November. From the records of the tallow works and incomplete survey studies it has been estimated that a total of approximately 3,000 horses and mules succumbed to the malady or were sacrificed on account of its sequelae. Close to 6,000 equine animals developed recognizable symptoms. About 50 per cent. of these cases terminated fatally. On one ranch with 687 horses and mules 67 contracted encephalomyelitis and 32 died.

At first the malady was quite generally diagnosed by veterinary practitioners as equine botulism but the spread of the epizootic suggested an infectious disease with an incubation time of from 1 to 2 weeks. Observations revealed febrile reactions preceding the onset of the symptoms which were manifest in form of psychic and motoric disturbances. Signs of fatigue, somnolence, and occasionally excitability, were followed by incoordinated action of the limbs, disturbed equilibriums, grinding of the teeth, paresis and paralyses which varied and were largely dependent on the lesions produced in the innervation centers of the nerves in the brain and the spinal cord. Inability to swallow, paralysis of the lips and bladder, amaurosis, etc., were quite common. In the mild cases which were able to rise recovery was as a rule uneventful and without demonstrable sequelae, but about half were so severe that they terminated fatally in 3 to 8 days or became so obviously hopeless on account of the complications in form of decubitus, pneumonia, etc., that they were destroyed for humane reasons.

---

[1] From the George Williams Hooper Foundation and the Division of Veterinary Science, College of Agriculture, University of California, San Francisco and Berkeley, California.

Aside from a slight general icterus and moderately succulent lymph-nodes, and parenchymatous changes in the liver and kidneys no gross anatomical lesions were found at autopsy. The spleen was not enlarged. As a rule the spinal fluid was slightly increased and showed 12 to 30 cells per cmm, mostly lymphocytes and a few leucocytes. The brain and cord were moist and injected.

The most obvious and striking microscopic changes in the brain consisted of hemorrhages around the vessels of the olfactory bulb, brain-stem, medulla and cord. Infiltration of the perivascular sheaths and spaces due to mononuclear and polymorphonuclear cells was variable in intensity. "Cuffing" of the veins and arteries was definite in the advanced cases of the disease. Scattered patches of infiltration in the gray and occasionally in the white matter were common. The distribution of the inflammatory foci differs from that commonly seen in typical Borna disease. Nuclear inclusions of the character described as typical of Borna disease by Joest and Degen were absent. Infiltrations in the lumbar plexus, semilunar and other peripheral ganglia suggest a wide distribution of the virus.

Blood cultures prepared from 10 horses were sterile while the spinal fluid of 11 horses sacrificed or dead on account of encephalomyelitis gave cultures of haemolytic and non-haemolytic streptococci. Certain sections of the brain of a few horses (4 out of 10) contained the same organisms in small numbers. They were non-pathogenic for rabbits and horses on subdural and intravenous inoculation. They were considered secondary invaders without etiologic significance.

Attempts were made to transmit the infection to rabbits by subdural and intracerebral injection of 20 per cent. brain and cord suspensions. The animals failed to manifest definite symptoms. Although moderate febrile reactions of short duration were recorded, the rabbits recovered promptly. Suspensions of the central nervous system of 8 equines sacrificed at different stages of the disease were tested on horses by intra-ocular, intranasal and intracerebral injections and feeding. The brain material from a case in the early stages of the infection produced on intra-ocular injection a fatal malady which was clinically indistinguishable from the San Joaquin Valley disease. Successive passages through horses, monkeys, rabbits, guinea-pigs, rats and mice and reverse transmissions from these animals have as a rule been successful. Clinically as well as anatomically the experimental disease is an acute virus infection identical with the spontaneous equine encephalomyelitis. The infective agent has thus far been demonstrated in the central nervous system by experimental inoculation from two field cases (horses No. 10 and 13). The failures in seven other attempts may be due to the selection of non-susceptible experimental animals, uneven distribution or absence of the virus in the central nervous system of the cases of prolonged duration (autosterilization) or unsuitable administration of the material. For example, the brain suspension of an acute case of encephalomyelitis tested on rabbits, horses and a monkey only produced a mild disease in the latter animal. The serum of this recovered monkey continues to neutralize the virus of horse No. 10.

Recent experiments indicate that the guinea-pig is regularly susceptible for the horse virus and the most suitable animal for an extended study of the disease and its causative agent. In these rodents the disease manifests itself in the form of a febrile reaction, flabbiness of the abdomen, hunched cat pose, salivation, tremors, trotting motions and death in from 4 to 6 days following the intracerebral injection of brain suspensions or filtrates. Not only intracerebral but intranasal instillations of brain emulsions have successfully transmitted the virus to guinea-pigs and rabbits, but not to horses.

The virus survived in one experiment preservation at 4° C. in 50 per cent. neutral glycerine for 12, 21 and 31, but not 105 days, when tested on horses and guinea-pigs. It is filterable through Berkefeld V and N candles and retains its activity in a dilution of 1:1000 although the incubation time may be slightly prolonged.

The nature of the immunity of the horse is unknown. Sera of spontaneously recovered or resistant horses fail to neutralize the virus while the sera of recovered rabbits, guinea-pigs and monkeys may contain antiviral substances.

K. F. Meyer
C. M. Haring
B. Howitt

BOOKS RECEIVED

Gates, William. *Extracts from Maya Society;* Publication No. 1. *Outline Dictionary of Maya Glyphs.* Pp. xii + 85. Illustrated. Johns Hopkins Press.

Imms, A. D. *Social Behaviour in Insects.* Pp. ix + 117. 20 figures. Dial Press. $1.50.

Rorem, C. Rufus. *The "Municipal Doctor" System in Rural Saskatchewan.* Pp. 84. University of Chicago Press. $1.00.

Science Society of China: Its History, Organization and Activities. The Society, Shanghai.

Sinai, Nathan and Alden B. Mills. *A Survey of the Medical Facilities of the City of Philadelphia: 1929.* Pp. 298. University of Chicago Press. $1.50.

Tisserant, R. P. Charles. *Dictionnaire Banda-Française.* Pp. 611. Institut d'Ethnologie, Paris. 110 fr.

SCIENCE

VOL. 74 FRIDAY, SEPTEMBER 4, 1931 No 1914

The Matamek Conference on Biological Cycles, 1931 DR. ELLSWORTH HUNTINGTON 229

Obituary

Calvin Henry Kauffman PROFESSOR E B MAINS *Memorials, Recent Deaths* 235

Scientific Events

The Meeting of the British Association, The International Convention of the Electrochemical Society, The Award of the Prize of the Research Corporation, The Proposed Surgical Building for Yale University, Therapeutic Trials Committee of the British Medical Research Council 236

Scientific Notes and News 239

Discussion

The "Rickettsiae" and the Intracellular "Symbionts" DR R. W GLASER. *The Cause of Mottled Enamel* DR. MARGARET CAMMACK SMITH, EDITH M LANTZ and H V SMITH *Relic of an Early Aerial Post* PROFESSOR S R. WILLIAMS 243

Scientific Apparatus and Laboratory Methods

The Abdominal Window DR. WALTER L MENDENHALL. *A Method for Ripening Haematoxylin Solutions Rapidly* DR E J KOHL and C M. JAMES 245

Special Articles

Sexual Rhythm in the California Oyster (Ostrea Lurida) PROFESSOR WESLEY R COE *Rice Bran, a Preventive of Perosis in Chickens* DR HARRY W. TITUS and W M GINN *The Formation of Glycine from Serine* PROFESSOR BEN H NICOLET 247

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa. Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE MATAMEK CONFERENCE ON BIOLOGICAL CYCLES, 1931[1]

By Dr. ELLSWORTH HUNTINGTON

YALE UNIVERSITY

DURING the last week of July, 1931, a biological conference of exceptional interest was held at the mouth of the Matamek River This place is on the north side of the Gulf of St Lawrence, 300 miles east of Quebec. The conference was called by Mr Copley Amory, of Boston, and all its members were his guests. For years Mr Amory has been interested in the fact that sometimes the fish, birds and mammals of that part of Canada are very abundant, and sometimes, for no apparent reason, very scarce. He has seen years when the cod were extremely abundant, and other years when practically no fish were caught. Salmon and all the animal population vary in the same inexplicable way. Therefore, at his summer home on the Matamek, Mr Amory brought together about thirty scientists and Canadian officials to consider the problem of fluctuations among wild life.

The conference began in Quebec where its members were tendered an official luncheon at the beautiful Falls of Montmorency Honorable Hector LaFerté, Provincial Minister of Colonization, Game and Fisheries, presided, and twenty or thirty other officials were present. The Canadian government as well as that of the Province of Quebec was much interested in the conference. Not only did Dr Charles Camsell, Administrator of the Department of Mines, act as chairman, but the Forestry Branch, National Parks Branch, Department of Fisheries, National Museum, and Dominion Observatory were all officially represented. The interest of the Canadians was also evident in the fact that the Lower St. Lawrence Transportation Company sent its ship, the *North Shore*, on two special trips of 160 miles each in order to carry the conferees free of charge between Rimouski and Matamek

---

[1] Report by Ellsworth Huntington, Yale University, in collaboration with an editorial committee and approved by the conference.

Fluctuations of all sizes and sorts were discussed. They included not only irregular fluctuations, but cycles with lengths of anywhere from 30 months up to 260 years or more Such fluctuations occur in trees, insects, fish of the sea, fish of the rivers, game birds, birds of prey, mice, rabbits and a dozen different fur-bearing animals that prey upon their smaller neighbors They also occur in the bacteria and other parasites which cause epidemics among animals and sweep them away by the millions Reproduction, diseases and deaths among human beings also came in for discussion Agricultural fluctuations and even financial panics were not neglected A number of solar, lunar and meteorological cycles were suggested as causes of the cycles in plants, animals and man.

Somewhat to the surprise of the conference the main discussion did not center around the well-known sunspot cycle of eleven years, but around shorter cycles of four years and especially nine or ten The four-year cycle was described by Dr A O Gross, of Bowdoin College, as being well shown by the migrations of the snowy owl into New England Mr Charles Elton, of Oxford, England, described the same cycle in far northern mice, lemmings and Arctic ptarmigan, and also in the Arctic fox and snowy owl which feed upon these lesser types of animals He stated that similar cycles occur in Britain, and also in Norway where lemming migrations have been known for hundreds of years In still another region, Alberta, Prof William Rowan, of the University of Alberta, has found a similar four-year cycle in mice and probably shrews

The regular course of events seems to be that the mice, lemmings and ptarmigan increase enormously in numbers for a season or two Foxes, owls and other creatures are thus provided with abundant food They, too, increase so fast that the number of skins brought in to the Hudson's Bay Company may be many times as great at one phase of the cycle as at another Then there comes a change so sudden that the members of the conference call it the "crash" The rodents and game birds begin to die by the thousand or million Some of them, such as the lemming, also migrate long distances, only to meet death in some other region The creatures that have been feeding on them soon become hungry They, too, begin to die, or else migrate to even greater distances. Snowy owls, for example, are described by Dr Blair, of the New York Zoological Society, and by Dr. Gross as moving from Canada to southern New England and New York by the thousand. They generally perish, for they do not appear to return north, and they can not breed so far south. A similar cycle of increase and sudden decrease was described by Mr. Aldo Leopold, of Wisconsin, as occurring among the red grouse of Scotland, but there the period is six years instead of four

The most remarkable feature of the biological conference was the great amount of evidence as to a cycle of nine or ten years Mr Leopold described such a cycle among the grouse and rabbits of Wisconsin and neighboring lake states In the United States as a whole his figures seem to show that the increase and sudden decrease of these same animals take more nearly ten years, but further work may show that the two periods are really the same One most interesting feature of the grouse is that those which live in the central and most favorable habitats apparently do not suffer violent fluctuations in numbers The sufferers are those on the edges, which happen also to be the parts less densely populated by man The findings of Mr Leopold are confirmed by those of Dr Gross who has studied the grouse in its more eastern habitat Among the rabbits of Canada, however, Mr Elton finds no evidence that fluctuations are less marked in the central area than on the margins In fact, the opposite may be true, but all Canada is marginal in the sense that it is subject to great extremes of climate

From the other side of the continent Prof Rowan, of the University of Alberta, presented evidence that in the plains around Edmonton a cycle of almost ten years is evident in grouse, some other non-migratory birds, and rabbits, and also in their enemies such as the coyote and other fur bearers Farther north in Canada the voluminous records of the Hudson's Bay Company have given Mr Elton abundant data which show a cycle of about ten years, or more exactly 9 7, in hares, muskrats, grouse, lynxes, red fox, marten, wolf, mink and goshawks The extraordinary thing about all this is not merely that many different animals show the same periodicity, but that the same period occurs in the far northwest of Canada, and all the way south into the United States The increase or decrease in the animal population appears to begin in the far north and to work its way southward and eastward, reaching southern Canada after about three years In spite of this the period of ten years or a little less is constant in each region

Still more astonishing are the results of Dr A. G. Huntsman, of Toronto University, Prof. E B Phelps, of Columbia University, and Prof. D L. Belding, of Boston University Medical School. Using the records of the commercial catch of salmon in the bays along the coast of New Brunswick, Dr. Huntsman found indications that the salmon come and go in periods of 9 6 years Professors Phelps and Belding used the very careful records of the salmon caught by the members of the exclusive Ristigouche Club on the Ristigouche River in New Brunswick Each fisherman there religiously records the weight and size of his fish and the number of days spent in fishing Thus it is easy to calculate the daily number of fish per rod or angler for each of the last fifty years There, too, the fish appear in great abundance every ten years, but sink to smaller numbers in the interim Curiously enough it is not because large or small numbers are hatched in special years, although such may be the case The greatest immediate cause of the change in numbers from year to year appears to be something which happens when the smolt, or young salmon, enter the sea

From far away on the other side of the continent the measurement of the annual rings of growth in the giant sequoias of California, by Dr Ellsworth Huntington, of Yale University, supplies still another type of evidence of this same cycle of about ten years Thus once in ten years or less something seems to happen which causes an increase and then a decrease in the vital activities of both plants and animals This occurs all over North America from the borders of Alaska to the Maritime Provinces and the northern United States, and also in the adjacent seas Then, to complete the picture, Mr Comsia, from Rumania, stated that he, too, has found some evidence of a ten-year cycle of disease in the rabbits not only of Canada, but possibly of Europe The European disease is coccidiosis, which may turn out to be an important disease in Canada Scraps of evidence, such as locust migrations, suggest that this same cycle prevails over still wider areas

Most of the members of the conference expected that the sunspot cycle of 11 2 years would figure prominently at Matamek Dr. H Mayer-Wegelin, of the German Forestry School at Munden in Hanover, did indeed present evidence of an 11-year cycle in the growth of German trees His colleague, Dr. H S Eidmann, showed that noxious insects which destroy the German trees have a cycle which is probably about 12 years Mr D R Cameron, of the Forestry Branch at Ottawa, pointed out that the increase of pests here and in Germany might be due to the influence of man in upsetting insect balance Moreover, Mr DeLury, of the Canadian Observatory at Ottawa, presented a large number of curves which seemed to show an 11-year cycle in tree-growth, agricultural production, the value of fish and the abundance of animals Nevertheless, the more detailed studies presented by other members of the conference suggest that many of the 11- or 12-year cycles may fit equally closely into a cycle of between nine and ten years, averaging approximately 9.5

One curious thing about this 9.5-year cycle is that while it can be detected in meteorological records, it has not been much studied there. Moreover, no basis for it, such as sunspots, has yet been found Mr DeLury pointed out that it is a little longer than the lunar cycle of 8 85 years and almost exactly half of another lunar cycle of 18 6 years These two cycles of tidal activity may influence climate by stirring up the ocean waters, allowing cold water to come to the surface, and thus influencing atmospheric pressure and storms This is not clear, however, and the conference felt that much more evidence was necessary before so seemingly minor a cause could logically be connected with such great events

The magnitude of the action of these cycles is still more evidence from certain facts pointed out by Dr Huntington He showed that the most distinct cycle of droughts and of agricultural productivity in the United States has a period of 18 6 years if measured by the five cycles between 1837 and 1930 Moreover, during that same time there have been six financial panics separated by five average periods of 18 4 years The panics, curiously enough, go with the agricultural depressions, but may precede or follow them. This suggests that the panics and the droughts may owe something to a common cause, even though the agricultural depression resulting from the droughts may not be the immediate cause of the panics. The conference made no attempt to solve such problems as this It was, however, impressed by the fact that droughts, panics and agricultural depression not only show greater regularity than the sunspot cycles, but seem to have a periodicity twice that of the very regular cycles found in sequoia trees, rabbits, grouse, foxes, salmon and many other animals

The evidence as to still larger cycles is scanty, but this may be due mainly to the absence of long records Dr Eidmann thinks that the noxious insects in the forests of Germany wax and wane in cycles of about thirty years Professor Rowan finds a cycle of 34 years in the ducks, crows, magpies and lake levels of Alberta. The Bruckner cycle of 30 or more years is also found by Mr DeLury in several series of meteorological data and in the growth of trees. The salmon statistics studied by Professor Huntsman seem to show a cycle of 48 years Still longer cycles are suggested by the rings of growth of trees, but these fall beyond the scope of the present conference. So far as the length of cycles is concerned the results may be summed up as follows. There is fairly abundant evidence as to a four-year cycle, the length of which seems to be almost exactly four years. A cycle of six years is suggested but not confirmed. A cycle of between nine and ten years, on the other hand, is very strongly indicated It is often called a ten-year cycle, but the most accurate determinations suggest that the true length is nearer nine and one-half years. A cycle of perhaps 18 6 years appears to be at least as widespread and definite as the four-year cycle. As to the larger cycles no data for gauging their importance were forthcoming at the conference

The causes of cycles in animals appeared to the conference to be divided into three groups biological, meteorological and astronomical The first includes food, reproduction, parasitic insects and diseases, especially those of bacterial origin, the second, or meteorological group, needs no definition; the third group may be briefly discussed before we turn to the others It was dealt with chiefly by Mr DeLury. He holds that the chief causes of climatic variation are partly solar and partly lunar The conference seemed to feel that while terrestrial climatic fluctuations are probably due to solar variations, such fluctuations are probably due to other astronomical causes as well as to the variations which manifest themselves as sunspots One of the strongest impressions of the whole conference was that all sorts of cyclic phenomena must be controlled, though not necessarily caused, by some outside forces which dominate all forms of life If these are solar forces, they manifest themselves as sunspots, prominences, faculae, the solar constant, electro-magnetic activity and perhaps still other phenomena These presumably lead to both meteorological and organic phenomena on the earth If lunar forces have any effect in producing cycles, they presumably act through the tides, which in turn give rise to oceanic currents and upheavals of cold water from below These are supposed to alter the atmospheric pressure and thus cause winds, storms, rain and changes of temperature

No one at the conference seemed to entertain much doubt that migrations of animals and variations in their numbers are often due to the food supply Some of the most clear-cut examples are the migrations of the snowy owls when the supply of mice runs short after a period of great abundance It is almost equally clear that the extraordinary variations in the numbers of rabbits, muskrats and other rodents from one extreme of the ten-year cycle to the other are one of the main causes for variations in the numbers of foxes, lynxes, mink and other fur-bearing animals Mr Elton's curves showing the numbers of skins of such animals brought in to the Hudson's Bay Company posts give good indication that the ups and downs of the furbearers follow closely on those of their prey, although the maximum number of the furs of carnivores is brought into the market a year after the maximum of rabbits. It was also made clear by various members of the conference that sea animals wander about in huge numbers in response to variations in their food supply One of the most interesting of such wanderings is the migration of the sperm whales described by Dr Charles Townsend of the New York Aquarium. The small crustaceans and other minute forms of life upon which these huge animals feed are abundant only in summer Therefore, in order to obtain the barrels and barrels of food which form their meals, the whales each year wander back and forth over routes six to eight thousand miles long During our summer they are in the northern hemisphere, and during the southern summer in the southern hemisphere

Such annual migrations, however, were only an incidental feature of the discussions The main interest in the wanderings of animals centered around those which recur at longer intervals. These generally represent great changes in the total number of living animals But the fish of the sea, as Dr Harry M. Kyle, of Glasgow, pointed out, show different phenomena from the animals of the land in this respect. Their numbers may vary enormously, but the fact that the fishermen do not catch the normal quantity of fish in any given year does not necessarily mean that there are fewer fish than usual in the sea The ocean is so huge that the best food supply, or the best spawning grounds, may lead the fish to concentrate in parts of the ocean where there is commonly little fishing Consequently the various conditions under which the fishermen do their work must be taken into account as well as the variable causes affecting the number of fish that hatch and survive In other words, the optimum years for the fisheries are by no means necessarily the optimum years for the fish.

In spite of the importance of the food supply there appeared to be a strong feeling that other causes of variations in the numbers of animals deserve more attention than is commonly given them. One such cause is the rate of reproduction. Mr Elton stated that the number of young snowshoe rabbits and other animals born in the average litter apparently tends to increase in certain years and to decrease when scarcity of food and other causes lead to a reduction in the number of animals Dr Huntington showed that even in man the rate of reproduction is very closely correlated with climatic conditions. A rapidly increasing race like the Japanese would decline in numbers if the relative rates of deaths and of conceptions resulting in living births stayed steadily at the levels of September when health and vigor are at a minimum. Professor Rowan presented experimental evidence suggesting that the same thing is true among birds. By altering the conditions of light and temperature he has induced birds to breed in midwinter Dr Kyle and Prof Huntsman made it clear that reproduction in fish and other sea animals responds with equal readiness to changes in temperature

One of the facts which the layman is only beginning to realize is the enormous number of parasitic worms and insects which infest most forms of animals, as well as plants. The importance of this in plants was explained by Dr Eidmann in respect to the forests of Germany He believes that the growth of trees is influenced quite as much by insects as by the climatic factors of temperature and rainfall The insects themselves, however, are very closely dependent upon these same climatic factors Thus the rate of growth of the trees is the composite result of the effect of climate upon the tree itself plus its effect upon the insects Dr Gross illustrated the same thing in respect to animals by means of the parasitic insects and worms which infest the organs of the grouse Professor Rowan showed how the reverse effect is obtained by removing ticks or other infestations and allowing an infested animal to regain its strength

In the production of cycles among animals an even greater part seems to be played by bacterial parasites and the diseases to which they lead than by the larger parasites This was especially well illustrated by Professor R G Green, of the University of Minnesota, in his discussion of tularaemia, a disease of rabbits and grouse He demonstrated clearly that during the last rabbit cycle in Minnesota the "crash" when the animals suddenly died off was due to a very virulent form of this bacterial disease. The disease is carried by ticks, which also infest grouse Professor Green's findings have resulted in the theory that when the rabbit population begins to decline the tularaemia bacteria are extremely virulent, while the proportion of old and immune rabbits is very small Hence millions of rabbits die, for the mortality is almost one hundred per cent. The ticks which they carry fall to the ground, but soon find new hosts in other rabbits and grouse, thus spreading the disease For some unknown reason, however, the virulence of the tularaemia bacteria decreases rapidly. After the epidemic it becomes so low that as young are born from the surviving rabbits they do not die from the disease, but have a non-fatal form of the disease which makes them immune. Thus there arises a group of immune rabbits, some of which survive the next epidemic and carry on the race.

Another epizootic disease which received considerable attention was encephalitis in dogs, foxes and other fur-bearing animals. This disease, as was shown by Messrs. Green, Elton and Anderson, behaves somewhat like rabies, except that the affected animals do not bite Here, unlike the case of tularaemia, we have a disease in which the resistance of the animal has a great effect in determining the occurrence and virulence of the disease In tularaemia the parasitic bacteria are so virulent at the time of their main onset that practically all affected animals die no matter how strong they may have been. Such facts as this precipitated a lively discussion as to the relative importance of changes in the virulence of the parasites compared with changes in the degree of resistance of the host The conclusion seems to be that there is no general rule Under certain conditions and with certain diseases the power of a disease varies in close harmony with the general health of the animals which it attacks Under other circumstances a more virulent parasite may be so strong that no animal can resist it But all organisms from bacterial parasites to whales appear to pass through cycles of strength and weakness arising from the combined effects of food, conditions of reproduction, parasites and the immediate climatic environment.

The features of the climatic environment most frequently discussed at Matamek were naturally temperature and rainfall Throughout the conference it was universally recognized that all forms of life have certain limits of temperature, and that between these limits lies an optimum or most favorable condition. According to Dr Huntington this optimum in man varies not only with the age of the individual, but also from one function to another Thus physical and mental activity have different optima of temperature. The optimum for reproduction may be still different, as was shown by Dr Kyle and others. Rainfall was not much discussed, although its importance was frequently recognized in discussing the food supply.

Three other atmospheric conditions were also brought to the attention of the conference One of these was ultra-violet light which was discussed mainly by Mr DeLury and Professor Rowan. The latter explained to the conference certain very interesting experiments now in progress which seem to show that the effect of ultra-violet light upon reproduction in birds is striking.

On the basis of an extensive study of deaths Dr. Huntington presented evidence concerning the effect of the relative humidity of the atmosphere upon human health and activity. He also pointed out that variability of temperature in itself has an important effect apart from that of the actual temperature. In New York City, for example, a moderate degree of variability from one day to the next is distinctly the best condition. Very high variability, to be sure, is not so conducive to health as is moderate variability, but very low variability is still worse. In other words a climate with frequent storms of moderate severity is more healthful than one with uniform weather all the time The conference seemed to feel that both relative humidity and variability of temperature are factors whose weight has not been fully recognized by biologists Dr Eidmann sustained this view by showing that among insects the effects of relative humidity and variability are almost the same as among men In fact one of the outstanding features of the conference was the frequency with which one member or another emphasized the fact that in spite of minor differences the general reactions of men, animals and even plants to physical environment are essentially the same Certain great laws seem to run all the way through the whole realm of life, and one result of the working of these laws is that cycles are very wide-spread phenomena

The phenomena discussed by the conference included not only cycles due to external causes, but those of a purely biological nature Thus Dr Belding called special attention to the variable life history of the salmon with its river stage, oceanic stage and final stage of return to the rivers for spawning The chief problem here is why the salmon vary in size, in age and in the length of their life cycle from one region to another and even from one river to its neighbor only a few miles away. Similar local and inexplicable variations are found in wholly different types of life such as the ticks described by Dr Green. On one side of the Bitter Root River, ticks carry a highly virulent disease, while on the other side their virulence is far lower When ticks are carried from one side of the river to the other they soon acquire the virulence characteristic of that side, no matter what may have been their previous condition

The abundance of the cod, a truly oceanic fish, was shown by Dr Kyle to follow laws which at first sight seem quite different from those governing the cycles so common in other creatures Since each female cod lays from one to five million eggs per year the danger of exterminating the species or even diminishing it by fishing seems to be negligible One of the most important features of certain fisheries, *e g*, herring and plaice, is that the animals are most abundant in the waters which have been most fully fished Thus herring have been taken from the North Sea abundantly for 1,200 years Yet to-day they are as abundant as ever, and perhaps more so Dr Kyle's explanation is that the fishing removes the old fish which consume much food, but nevertheless grow slowly. Where the fish are young, a given supply of food produces a maximum amount of growth and thus a maximum supply of food for man From this standpoint fishing is like agriculture; that is, human activity leads to an optimum condition for man by reason of the rapid growth of the fish Prof. J. R Dymond, of the University of Toronto, stated that the same rule applies in the case of several fresh water fishes

A general review of the mammals of the world, by Mr H E Anthony, of the American Museum of Natural History of New York, illustrates some of the main conclusions of the conference as to the distribution of cycles In a broad way the land mammals of the earth are at a minimum in the great tropical forests There, too, so far as our present information goes, such animals are least subject to cycles This may be because of the general scarcity of mammals in those areas, and also because the environment is so uniform that there is apparently little reason for great changes in numbers Outside of such forests lie tropical regions where there is more grass and smaller trees There the mammals increase greatly in numbers and we have such areas as the famous game regions of Africa In such areas the number of animals is often incredibly large As yet we have no definite evidence as to whether the fluctuation in numbers is correspondingly great, even though the variations from wet seasons to dry are extreme In higher latitudes, as has already been implied, there are likewise certain rather steady areas such as the eastern United States where many animals live under conditions which approach the optimum and where extremely harmful variations in climate are comparatively rare Thus in such regions the cycles in animal numbers are mild In the marginal regions, however, such as the drier and colder parts of the continents, it requires only a slight departure of the climate from its normal condition to produce great changes in the food supply and in the conditions of reproduction and bacterial infection. Thus in those regions animals increase enormously at certain times and then decline with a crash The same contrast between areas of relative uniformity and variability is perhaps seen in the cod, plaice and salmon The cod and plaice, even though the fishermen can not find them, appear to be numerous at all times and may suffer relatively little from cyclic variations in numbers This may be because they inhabit a relatively uniform region where the temperature and food supply vary but little. The salmon, on the contrary, because of its habit of coming to the rivers to spawn, occupies a marginal area. Not only is it subject to great variations in most of the conditions which control its numbers, but when the smolt pass from fresh water to the salt sea, they are subject to an environmental change unknown to the purely marine fish.

The conference closed with a general session on conservation and allied topics Mr. D R Cameron added new strength to what he had previously said as to the importance of forest fires Dr Harrison F Lewis, of the National Parks Branch at Ottawa, told about the Canadian game sanctuaries Dr. Anderson drew attention to the importance of museum collections as a factor in cooperative field studies upon wild animals It is useless to make observations upon wild animals if the species that is studied is not properly identified The conference as a whole was strongly in favor of intelligent conservation It was pointed out, however, that in some cases our conservation measures go so far that they defeat their own ends, as when deer ruin gardens or die for lack of food, or big fish eat the food that ought to be left for rapidly growing young fish, an eventuality unlikely to arise in the case of land animals In other words, conservation, like almost everything else, has an optimum Until the optimum is reached it is highly desirable, but beyond that it goes too far

OBITUARY

CALVIN HENRY KAUFFMAN

Calvin Henry Kauffman died at Ann Arbor, Michigan, on June 14, 1931, following a stroke of paralysis that occurred in February, 1930 He was born on March 10, 1869, near Lebanon, Pennsylvania, and received his preparatory training in a country school near Lebanon and at Palatinate College, Myerstown, Pennsylvania In 1896 he graduated from Harvard University with the A B. degree, specializing in Greek and Latin From 1896 to 1898 he was principal of a preparatory school at Lebanon, Pennsylvania He taught in a high school at Decatur, Indiana, from 1898 to 1900 and at Bushnell College, Bushnell, Illinois, from 1900 to 1901

In 1901 he decided to take advanced training in science at the University of Wisconsin, specializing in chemistry and botany Here he came under the influence of Professor R A Harper, who was responsible for definitely directing his interest in the field of mycology The following two years (1902 to 1904) were spent as an assistant and graduate student with Professor G F Atkinson at Cornell University Under Atkinson's influence his interest in the agarics was stimulated and developed In 1904 he was appointed an instructor in the botany department at the University of Michigan, where he continued his graduate studies, stressing the physiological phases, receiving his Ph D degree in 1907, with a doctorate dissertation entitled "A Contribution to the Physiology of the Saprolegniaceae with Special Reference to the Variations of the Sexual Organs."[1]

The rest of his life was spent at the University of Michigan, where he developed courses and directed research in algae, mosses and ferns, mycology and forest pathology He was advanced to the rank of assistant professor in 1912 and associate professor in 1920 In 1921 he was made director of the University Herbarium and in 1923 became professor of botany. From 1917 to 1919 he was on leave from the University of Michigan for the purpose of serving as pathological inspector with the Federal Horticultural Board of the United States Department of Agriculture He was a fellow of the American Association for the Advancement of Science and a member of the American Botanical Society, Torrey Botanical Club, Société Linnéenne de Lyon, Washington Botanical Society, Michigan Academy of Science, Arts and Letters, Sigma Xi and the American Forestry Association

Dr. Kauffman was outstanding both as an investigator and teacher His interest in the agarics resulted in numerous papers concerning the taxonomy of various genera, especially Cortinarius, Inocybe, Lepiota, Clitocybe, Gomphidius and Armillaria. His "Agaricaceae of Michigan"[2] serves not only as an exhaustive and critical treatment of the agarics of Michigan but as a standard reference for the species described In addition he published papers concerning various species of Phycomycetes, Gasteromycetes, Thelephoraceae and Polyporaceae as well as numerous mycological floras of Michigan and other states. He had a broad knowledge of the fungi of the United States gained from many summers spent in the field collecting in Michigan, New York, Pennsylvania, Maryland, Virginia, Kentucky, Tennessee, Montana, Colorado, Wyoming, Idaho, Oregon and Washington. He also contributed publications in the field of plant pathology, especially concerning the rots and mycorrhizas of trees His broad interests have been reflected in the choice of subjects for investigation by his students who have been guided by him in studies concerning algae, bryophytes, ferns and among fungi have studied problems in all the major groups. He never lost his early interest and enthusiasm in teaching His students will always remember him for the example which he set by his untiring enthusiasm in research and for the inspiring criticism and encouragement which he always freely gave

E B Mains

University of Michigan

---

[1] *Ann. Bot.* 22: 361–387, 1908.

[2] *Mich. Biol. Geol. Surv* 26: Biol. Ser. 5, 1918

MEMORIALS

We learn from the *New York Times* that in commemoration of the hundredth anniversary of the death of the great French astronomer and mathematician, Pierre Simon de Laplace, which occurred in 1927, a memorial monument will be erected in the town of Beaumont, France, where he was born It will be of bronze on a granite pedestal The statue will probably be exhibited in the next Paris Salon and dedicated some time during the summer of 1932

Nature reports that on July 28 a memorial tablet to Thomas Earnshaw, the horologist, was unveiled outside the Church of St Giles-in-the-Fields, Bloomsbury, by the Astronomer Royal, Sir Frank Dyson The tablet has been erected by the Clockmakers' Company and the British Horological Institute Like his predecessors, Graham and Harrison, and his contemporaries, Mudge and Arnold, Earnshaw came from the country, having been born at Ashton-under-Lyne, Lancashire, on February 4, 1749, but for many years he had a business at 119 High Holborn To him is ascribed the merit of devising the chronometer escapement and compensation balance precisely as they are now used, while it was he and Arnold who first produced chronometers in large numbers and at moderate cost, thus rendering service of the utmost value to navigation and commerce His improvements were recognized by the commissioners of longitude, and he was awarded £3,000 by the government. His death took place in Chenies Street, Bedford Square, on March 1, 1829, and he was buried in St. Giles-in-the-Fields, where it was his custom to worship He had published a pamphlet in 1806 entitled "Explanation of Timekeepers constructed by the Author and the late Mr John Arnold," and another in 1808 stating his own claims to the invention of improvements in timekeepers

RECENT DEATHS

Dr. C L Bristol, emeritus professor of biology at New York University, died on August 27 at the age of seventy-two years

Dr. James T. Porter, head of the department of physics at the University of Tennessee and assistant dean, died on August 27 Dr Porter was fifty-seven years of age

Dr William Parker Booke, professor emeritus of preventive dentistry and oral hygiene at Harvard University, died on August 25 at the age of seventy-two years

Dr. Archie H Kirkland, consulting economic entomologist, died on September 29, at the age of fifty-eight years

Dr George G Brownell, whose work has been the culture of citrus fruit in connection with the U. S. Department of Agriculture, died on August 28 at the age of sixty-two years.

SCIENTIFIC EVENTS

THE MEETING OF THE BRITISH ASSOCIATION

From September 23 to 30 the Centenary meeting of the British Association meets in London for the first time in its history The reception room of the Imperial Institute at the University of London will be open on Tuesday, September 22

General Smuts will assume the presidency in succession to Professor F O Bower in the Albert Hall on Wednesday, September 23, and will receive the invited delegates of societies and institutions, and of universities, colleges and cities in which the association has held meetings in the past. On the evening of the same day General Smuts will deliver his presidential address, of which the subject is "The Scientific World Picture of To-day," in the Central Hall, Westminster. The address will be relayed to other halls and will be broadcast. The work of the sections of the association will begin on September 24 and will be continued until September 30

The presidential addresses in the sections are to be spread over several days and include the following: Section A (Mathematical and Physical Science), Sir J. J Thomson on "The Growth in Opportunities for Education and Research in Physics in the Past Fifty Years", Section B (Chemistry), Brigadier-General Sir Harold Hartley on "Michael Faraday and the Theory of Electrolytic Conduction", Section C (Geology), Professor J W. Gregory; Section D (Zoology), Professor E. B Poulton, F R.S., on "A Hundred Years of Evolution"; Section E (Geography), Sir Halford J. Mackinder on "The Human Habitat"; Section F (Economic Science and Statistics), Professor E. Cannan on "Internationalism in Economic Theory"; Section G (Engineering), Sir Alfred Ewing on "Power", Section H (Anthropology), Professor A R. Radcliffe-Brown; Section I (Physiology), Dr. H. H. Dale on "The Biological Nature of Filtrable Viruses"; Section J (Psychology), Dr. C. S. Myers on "The Nature of Mind"; Section K (Botany), Professor T. G. Hill on "The Advancement of Botany"; Section L (Educational Science), Sir Charles Grant Robertson on "Educational Theory, 1831 and 1931"; Section M (Agriculture), Sir John Russell on "The Changing Outlook in Agriculture."

Evening discourses are to be given by Professor W.

A. Bone on "The Photographic Analysis of Explosion Flames," Sir Peter Chalmers Mitchell on "Zoos and National Parks," Sir Arthur Keith on "The Construction of Man's Family Tree," Sir Oliver Lodge on "A Retrospect of Wireless Communications," Sir James Jeans on "Beyond the Milky Way," and Dr S Kemp on "Oceanography in the Antarctic"

A public lecture, non-members included, will be given by Mr Angus Macrae on "Guidance in the Choice of an Occupation," at 3 30 P M on Monday, September 28, in the London School of Economics Other public lectures will be arranged in several of the polytechnic institutions

Receptions will be given as follows At the National Physical Laboratory, Teddington, in connection with the visit on Thursday afternoon, September 24, at Bedford College for Women, Regent's Park, N W 1, on Thursday afternoon, September 24, from 4 to 6 P M, by the Royal Society to invited delegates, in connection with the Faraday Centenary Celebration, on Thursday evening, September 24, by H M Government in the Imperial Institute on Friday evening, September 25, beginning at 9 P M, by the founder and director of the Wellcome Historical Medical Museum on Friday evening, September 25, beginning at 8 30 P M, at the Hampton Court Palace on Saturday afternoon, September 26, in the Court and the Senate of the University of London and at the Wellcome Historical Medical Museum on Monday evening, September 28, at the Forum Women's Club, on Tuesday afternoon, September 29, by the Right Honorable the Lord Mayor and Corporation of the City of London, on Wednesday evening, September 30, at Guildhall

The reception of members has also been arranged in connection with many other excursions and visits

An invited party will visit York, the birthplace of the association, on Saturday and Sunday, September 26 and 27 Down House, the home of Darwin, now held by the association in custody for the nation, will be open to members throughout the meeting

Interesting exhibits of importance have been arranged at various institutions during the meetings

THE INTERNATIONAL CONVENTION OF THE ELECTROCHEMICAL SOCIETY

PROFESSOR JOHN A FULTON, director of the Mackay School of Mines, Reno, Nevada, invited authorities on silver to present their views at a luncheon and round table discussion, held at the Hotel Utah, on Thursday, September 3, in connection with the international convention of the Electrochemical Society meeting from September 2 to 5 in Salt Lake City The state of Utah is the largest silver-producing state in the union, furnishing over 25 per cent. of the total production in the United States Mining, metallurgy and the utilization of silver were carefully considered.

On Wednesday, September 2, an entire session was devoted to cyanides in metallurgy, which has an important bearing on the gold situation Due to many improvements made in the cyanide process, gold can to-day be recovered from ores which were formerly considered worthless Dr Dorsey A Lyon, of the University of Utah, presided

A session on miscellaneous electrochemical papers took place on Thursday, September 3 Professor Jean Billiter, of the University of Vienna, Austria, described his new electrical apparatus for the purification of drinking water Dr M Sem, of Oslo, Norway, presented data on the new Soderberg electrode This electrode is from four to five feet in diameter and has been used with success in the production of carbide Mr W E Moore, well-known furnace expert of Pittsburgh, reported on the latest developments in electric furnace design

The Edward Goodrich Acheson Medal was presented to Dr Edwin Fitch Northrup, vice-president of the Electrothermic Corporation, of Trenton, New Jersey, on September 3 An award of $1,000 in cash accompanies the medal Dr Northrup is well known for his work in electric furnace design After the award of the medal, Dr Northrup addressed the members and guests on "What is Electricity?"

Flotation, the process by which valuable metals in any ore can be readily and cheaply segregated, is the subject of the symposium, to be held on Saturday, September 5 Professor A M Gaudin, of the Montana School of Mines, will preside This metallurgical process was invented by Miss Carrie J Everson, of Denver, Colorado The introduction of flotation has completely revolutionized mining and metallurgy within the last ten years Among those who will participate in the symposium are Professor Herbert Freundlich, of Berlin, Dr Oliver C Ralston, of the United Verde Copper Company, Dr Edmund S Leaver, of the U S Bureau of Mines, and four engineers of the American Cyanamid Company

THE AWARD OF THE PRIZE OF THE RESEARCH CORPORATION

DR ANDREW ELLICOTT DOUGLASS has received the $2,500 prize of the Research Corporation through the Smithsonian Institution for his work in establishing the date of the construction of Pueblo Bonito in Northern Mexico by the measurement of tree rings The field work was done on the pre-Columbian Beam Research Expedition of the National Geographic Society of which Dr Douglass was leader.

In the report of his work to the National Geographic Society Dr. Douglass wrote:

By translating the story told by tree rings we have pushed back the horizons of history in the United States for nearly eight centuries before Columbus reached the shores of the New World, and we have established in our Southwest a chronology for that period more accurate than if human hands had written down the major events as they occurred

We are now able definitely to announce the important dates in the history of Pueblo Bonito, oldest and largest of the great Indian communities, in Chaco Canyon, New Mexico

Furthermore, we can now date nearly forty prehistoric ruins in the Southwest and reconstruct there a succession of major events through which Indian settlements rose, passed their heyday and disappeared

Just as the far famed Rosetta Stone provided the key to the written mysteries of ancient Egypt, so the collection of an unbroken series of tree rings has made clear the chronology of the Southwest

Through this work we have learned of some outstanding events in America which were contemporaneous with the conquest of Spain by the Moors, and we know that certain Pueblo Indian settlements were enjoying their golden ages when William the Conqueror faced Harold the Saxon at the battle of Hastings

These researches have carried the calendar back to A D 700 in the Southwest, and they have provided the beginnings of a continuous weather chart for 1,200 years

The earliest beam we recovered from Pueblo Bonito was cut A D 919 from a tree that was 219 years old when cut Pueblo Bonito had reached its golden age in 1067 and was still occupied in 1127

The method which we have used in extending the historical calendar of the Southwest is the outcome of a long attempt to read the diaries of trees Every year the trees in our forests show the swing of time's pendulum and put down a mark They are chronographs, recording clocks, by which the succeeding seasons are set down through definite imprints Every year each pine adds a layer of new wood over its entire living surface of trunk and branches

If every year were exactly the same, growth rings would tell the age of the tree and little more Only in rare cases would they record exceptional events of any interest to us.

But a tree is not a mechanical robot, it is a living thing, and its food supply and adventures through life all enter into its diary A flash of lightning, a forest fire, insect pests or a falling neighbor may make strong impressions on its life and go into its diary

But in the arid regions of our Southwest, where trees are few and other vegetation scarce, the most important thing to man and trees is rainfall This fact has helped vastly in our dating work, for certain sequences of years become easily recognized from tree to tree, county to county, even from state to state

THE PROPOSED SURGICAL BUILDING FOR YALE UNIVERSITY

A FUND of $1,100,000 for a surgical building for Yale University at the New Haven Hospital is provided by the bequest of Mrs. Sarah Wey Tompkins, whose father, Dr. William C. Wey, served the community of Elmira, New York, for half a century as a leading physician and surgeon. Mrs. Tompkins during her lifetime gave to the university the tract of land near the Yale Bowl, now known as the Ray Tompkins Memorial, in memory of her husband In her will, she made a bequest to Yale which has proved sufficient to enable the university now to proceed in accordance with the wishes expressed by the donor prior to her death Work on the new building, to be known as the Sarah Wey Tompkins Memorial, will soon be begun

The erection of this unit brings near to completion the modernization of the entire physical plant of the New Haven Hospital, in accordance with a plan adopted five years ago Three sections of the hospital must still be provided These are the pavilion for contagious diseases, an addition to the private pavilion for persons of moderate means and a women's pavilion The completed plant will then represent an investment of $8,000,000 in buildings, of which approximately $6,500,000 has now been obtained.

The new building will have five hospital floors, and a ground floor for "out-patient," or dispensary, service. On the ground floor will be the examining and treatment rooms for surgery, including orthopedics, urology, physical therapy and accident and emergency units The first floor will have 27 beds for male surgical patients, the second floor, 27 beds for women requiring general surgical treatment, the third floor, 24 beds for gynecological patients, the fourth floor, a nursery and 20 beds for obstetrical cases, and the fifth floor, 27 beds for eye, ear, nose and throat cases.

Each of the ward floors will have a treatment room, diet kitchen, doctors' room, nurses' room, solarium and open air balconies, and will thus have practically all facilities required for a hospital, with the exception of operating rooms, which have been placed in the Farnam building adjoining There will be twelve single-bed rooms on each floor, one eight-bed room, and several two-bed and three-bed rooms.

Staff members in the department of surgery and the department of obstetrics and gynecology have their offices and research and teaching facilities in the Farnam Memorial Building, to which the new surgical pavilion will be connected on every level. Similar facilities for members of the department of internal medicine are provided in the new medical and pediatric laboratory building, with which the Raleigh Fitkin Memorial Pavilion and the proposed pavilion for infectious diseases will be connected. This arrangement will bring all the required facilities close together.

When the three new units still needed in order to complete the hospital have been provided, there will be about 440 ward beds for those who can not pay the full cost of hospital care and about 160 beds for patients who can meet this cost.

THERAPEUTIC TRIALS COMMITTEE OF THE BRITISH MEDICAL RESEARCH COUNCIL

ACCORDING to the London *Times*, the British Medical Research Council announce that they have appointed a Therapeutic Trials Committee, as follows, to advise and assist them in arranging for properly controlled clinical tests of new products that seem likely, on experimental grounds, to have value in the treatment of disease.

Professor T. R. Elliott, physician to University College Hospital, London, *chairman*
Sir E. Farquhar Buzzard, regius professor of physics, University of Oxford.
Dr. H. H. Dale, director, National Institute for Medical Research.
The Right Honorable Lord Dawson of Penn, president, Royal College of Physicians, London.
Professor A. W. M. Ellis, physician to the London Hospital.
Professor F. R. Fraser, physician to St. Bartholomew's Hospital, London.
Sir John Parsons, ophthalmic surgeon to University College Hospital, London.
J. A. Ryle, physician to Guy's Hospital, London.
Sir John W. Thomson-Walker, consultant urologist to King's College Hospital, London.
Wilfred Trotter, surgeon to University College Hospital, London.
Professor D. P. D. Wilkie, surgeon to the Royal Infirmary, Edinburgh.
F. H. K. Green, *secretary*

Conditions have been the subject of discussion and agreement between the Medical Research Council and the Association of British Chemical Manufacturers, under which the Therapeutic Trials Committee will be prepared to consider applications by commercial firms for the examination of new products, submitted with the available experimental evidence of their value, and will arrange appropriate clinical trials in suitable cases. The committee will work in close touch also with the existing Chemotherapy Committee, who are engaged for the Medical Research Council in promoting researches aimed at the discovery and production of new remedies.

The Therapeutic Trials Committee will invite suitable experts in particular branches of medicine or surgery to undertake the clinical tests of preparations accepted for trial. The reports upon the results will be published under the authority of the committee.

SCIENTIFIC NOTES AND NEWS

DR. ROBERT A. MILLIKAN, of the California Institute of Technology, has been made Knight of the Legion of Honor by the French Government.

PROFESSOR RUFUS H. PETTIT, head of the department of entomology at Michigan State College, received the honorary degree of doctor of science at the commencement exercises at the college, in recognition of his high attainments as an investigator and teacher and of "his thirty-four years of loyal and efficient service."

DR. M. LUCKIESH and Frank K. Moss, of the Nela Research Laboratory of the General Electric Company, Cleveland, have been awarded the gold medal of the Distinguished Service Foundations of Optometry.

IT is announced in the *British Medical Journal* that a fund is being inaugurated in order that the friends, colleagues and pupils of Colonel Thomas Sinclair, emeritus professor of surgery in Queen's University, Belfast, may have an opportunity to express their appreciation of his invaluable services to the Belfast Medical School. Professor Sinclair occupied the chair of surgery from 1886 to 1923. The testimonial will probably take the form of a portrait to be painted and presented to the university.

PROFESSOR ARIENS KAPPERS, director of the Central Institute for Brain Research, Amsterdam, recently received the honorary degree of doctor of science from the University of Dublin. Professor Kappers delivered three lectures on diseases of the brain while in Dublin.

DR. BERNHARD FISCHER, professor of pathology at Frankfurt, has been elected an honorary member of the Royal Institute of Public Health, London.

DR. VICTOR MORITZ GOLDSCHMIDT, of Gottingen, has been elected a corresponding member of the Geological Society at Stockholm and a foreign member of the Geological Society of London.

M. JACOB, professor of geology at the Sorbonne, has been elected a member of the French Academy of Sciences.

COLONEL CHAS. F. CRAIG, director of the department of preventive medicine and clinical pathology at the Army Medical School, has been appointed professor of tropical medicine and director of the department at Tulane University Medical School

PROMOTIONS to full professor at New York University are as follows Professors Elmer G Hooper, hydraulics, C Theodore Schwarze, civil engineering, Newman L Hoopingarner, business psychology, and Ira Kaplan, clinical professor of surgery Promotions to associate professor are Dr W H Crew, physics, Professors Otto Halpern, physics, and David Porter, industrial engineering Promotions to assistant professor are Professors C T Chase, physics, and Donald Flanders, mathematics New appointments are as follows T A Jackson, visiting assistant professor of psychology, and A C G Mitchell, assistant professor of physics At Washington Square College promotions to assistant professor were Professors Harry A Charipper, biology, and Francis Holden, psychology T C Schneirla has been appointed assistant professor of psychology

DR JOSEPH L JOHNSON, of Philadelphia, has been appointed head of the department of physiology in the School of Medicine of Howard University

DR J J DURRETT, chief of Drug Control, Federal Food and Drug Administration, has tendered his resignation Dr Durrett will be succeeded by Dr Frederick J Cullen, chief medical officer of the administration

DR JOHN D BLACK, professor of economics at Harvard University, has been appointed chief economist of the Federal Farm Board He will devote only part of his time to this work and will continue as usual at Harvard University Dr Black succeeds Dr Joseph S Davis, who has been on leave of absence from Stanford University and who will return there as a director of the Food Research Institute The Farm Board also has announced the appointment of Dr M J B Ezekiel and G C Haas as assistants to Dr Black

DR. A K PARPART, who received his doctor's degree from the University of Pennsylvania this spring, has accepted an appointment as instructor in the department of physiology at Princeton University

PROFESSOR JAMES GARFIELD HALPIN, head of the poultry department at the Wisconsin College of Agriculture, was elected president of the National Poultry Science Association at its annual meeting recently held at the University of Kentucky Other officers chosen for the coming year are Dr Fred Hutt, of the University of Minnesota, *first vice-president,* Professor Duncan H Reid, of the Texas Agricultural and Mechanical College, *second vice-president,* and W A Maw, Macdonald College, Canada, *secretary* The 1932 meeting will be held at Massachusetts State College

A MICROSCOPE was presented to Professor Ludwig Aschoff, of Freiburg in Breisgau, Germany, who has worked primarily in the field of pathology and anatomy, by the Optical Works of E Leitz, in Wetzlar, Germany, after having completed their 300,000th microscope The dedication of this microscope follows a custom of the firm of E Leitz to present every 50,000th microscope to an outstanding scientific man or institute The names of the institutions and scientific men who have received the 50,000th microscopes are as follows German Tuberculosis Sanitarium in Davos, Switzerland, Dr Robert Koch, of Berlin, Dr Paul Ehrlich, of Frankfurt, Dr Martin Heidesheim, of Tubingen, the Institute for Tropical Hygiene in Hamburg, and Dr Ludwig Aschoff, of Freiburg in Briesgau

MR ERNEST H VOLWILER has been elected president of the Chicago Chemists Club Other officers were elected as follows Bruce K Broun, *first vice-president,* Walter J Bently, *second vice-president;* Louis Ehrenfeld, *treasurer,* and Charles D Lowry, Jr, *secretary*

DR WILBUR K. BUTTS, assistant professor of biology at James Millikin University, will replace Dr Wyman R Green as head of the department of biology at the University of Chattanooga Dr Green will direct the department of biology of Drew University

MR HUGH M WOLFIN has been appointed supervising engineer of the Intermountain Experiment Station of the U S Bureau of Mines at Salt Lake City, Utah

MR. F N MOWDAWALLA has been appointed professor of electrical technology in the Indian Institute of Science, Bangalore Mr Mowdawalla has succeeded Professor J K Catterson-Smith

MR. SAMUEL LEES has been appointed to the Chance chair of mechanical engineering at the University of Birmingham, England, in succession to Professor F W Burstall

DR. THOMAS FOTHERINGHAM MACRAE has been appointed to a research studentship in biochemistry at the Lister Institute

DR J MCKEEN CATTELL, editor of SCIENCE, sailed for England on August 26 in order to attend as the delegate of the American Association for the Advancement of Science the centenary meeting of the British Association

DR. DOUGLAS JOHNSON, professor of physiography at Columbia University, has sailed for Paris on the North German Lloyd liner *Berlin*, as a delegate to the International Geographic Congress

DR H J GERSTENBERGER, professor of pediatrics in the School of Medicine of Western Reserve University, Cleveland, has gone to Europe to address the German Pediatric Society meeting in Dresden in September

DR CHARLES H HERTY, adviser to the Chemical Foundation of New York, has been appointed to direct a pine pulp mill, where he will experiment on the manufacture of newsprint, to be established in Georgia in January, 1932, with the cooperation of the newly created Department of Forestry and Geological Development of Georgia The Chemical Foundation has donated $50,000 to match the $20,000 appropriation made recently by the Georgia Legislature for the mill For several years Dr Herty has experimented in making paper from pine

DR LUDWIG WEICKMANN, director of the Geophysical Institute of Leipzig, will conduct experiments in the temperature of trade winds in the *Graf Zeppelin* with a miniature airship trailed from the dirigible on a cable The *Graf Zeppelin* will fly over France, Spain and the Canary Islands

ACCORDING to the London *Times*, Professor Auguste Piccard has decided to make a second ascent by balloon before presenting the report on his recent ascent into the stratosphere to the Belgian Fonds National de Réchercle Scientifique In this second ascent he will not go higher than 4,000 or 5,000 meters (13,000 to 16,000 feet) His object will be to verify certain observations that he made in the stratosphere

THE geology car from Princeton University, which, under the direction of Professor Richard Montgomery Field, has carried twenty-seven professors and students through Jasper Park to Vancouver, B C, and finally to Red Lodge, Montana, for study of rock formations, returned to Princeton on August 26 Dr Kenneth H Condit and Mr Erling Dorf, of the university faculty, were members of the party

THE Madrid Surgical Society has been formed by Dr J. Goyanes and a committee of leading Spanish surgeons to encourage surgical research throughout the country and to raise the status of the profession The new society proposes to encourage the formation of similar bodies in the provinces, and so prepare the way for a National Association of Spanish Surgeons

WE learn from *Nature* that a large meeting of biologists, including leading representatives of genetics, medicine and anthropology, was held at the London School of Economics on July 21, to consider the question of the present state of research in human genetics and to explore the possibilities of its immediate development The lack of facilities for research in a subject so vital to the human race as human genetics was generally deplored, and it was decided to seek ways and means to establish in London a central body of experts, who would organize, develop and foster sound research in human genetics within the Empire by means of grants obtained from various sources The following committee, with power to add to its number, was appointed to take immediate action Sir Daniel Hall, *chairman*, Sir William Beveridge, Professor F A E Crew, Sir Walter Morley Fletcher, Professor R Ruggles Gates, Professor J B S Haldane, Professor Lancelot Hogben, Sir Bernard Mallet, Dr Redcliffe Salaman, Professor C G Seligman, and Dr C C Hurst, *secretary*

THE University of Oregon Medical School is in receipt of information that the Research committee of the American Medical Association has made a grant of $500 to Dr George E Burget, professor of physiology, for the prosecution of continuing research in the closed intestinal loop This represents the fourth grant conferred by the committee for the study of this problem The committee has also given a grant of $600 to the laboratories of research surgery and research medicine, of the University of Pennsylvania, for work on the function of the gall bladder

THE John F Cushing Hall of Engineering, the gift of John F Cushing, president of the Great Lakes Dredge and Dock Company of Chicago, is now under construction at the University of Notre Dame An extensive building program started at the University of Notre Dame last winter will be practically completed late in September, giving to the institution two of the most modern dormitories in the Middle West The buildings will bring the number of residence halls at Notre Dame to fourteen, thus providing quarters for more than 2,600 students One of the new structures will be called Alumni Hall and the other Dillon Hall

THE first Congress of Electrical Engineers in South America will be held at Buenos Aires from July 4 to 11, 1932 The principal purpose of the congress is to afford an opportunity to interchange ideas Tentative programs have been issued and an invitation has been extended to those who go to prepare discussions on some one of the thirty-six subjects suggested or upon other topics The organization committee comprises fifteen sections, each to be presided over by a well-known engineer The general secretary of the congress is Robert S Ascher, of Buenos Aires

PROFESSOR NELLO BECCARI and DR. GUIDO GIGLIOLI are leading an expedition of the Italian Royal Geographic Society which is on its way to British Guiana for six months to conduct zoological and colonial agricultural study.

According to the London *Times* the largest scientific party ever sent to Central Australia left Adelaide, Australia, on August 9 for Alice Springs, to study the aborigines and vegetation, birds and animals. The party includes three professors, four medical men, three museum specialists and a cinematographer, and has been organized by Adelaide University, which is continuing and amplifying the studies made by previous expeditions. From Alice Springs the party will proceed several hundred miles northwest, where there are tribes of uncivilized aborigines whose life will be studied. Their language and chants will be phonographically recorded. Scouts have been out some weeks bringing in aborigines, who are establishing a special camp.

The National Metal Congress and Exposition will take place in Boston during the week of September 21. An extensive exhibition of metals and metal products will be held in connection with the meetings. The congress and exposition are sponsored annually by the American Society for Steel Treating and will be held this year in Boston for the first time since 1924. The four following national technical societies will also meet as part of the congress: the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Welding Society and the Society of Automotive Engineers. The exposition will be on Commonwealth Pier, where more than two hundred manufacturers of metals and metal products will occupy 100,000 square feet of exhibit space.

A scientific expedition to the Arctic has been approved by the U. S. Navy Department to study the aurora borealis for two years under the leadership of Captain F. M. Williams. The expedition will leave in June, 1932, on the fiftieth anniversary of the establishment of the first polar meteorological stations. America was represented in 1882 by the Greely expedition at Fort Conger, Grant Land, which has been selected as the base of the Williams expedition. The expedition has already acquired the services of a Swedish icebreaker, and two airplanes and dogteams will be used. It is proposed to photograph from the air 100,000 square miles of the extreme northern portion of Perry Land. Among the organizations which are said to be cooperating with the expedition are the International Polar Year Commission, the Carnegie Institution, Department of Terrestrial Magnetism, Naval Research Laboratory, the Naval Hydrographic Office and the United States Weather Bureau.

Afternoon and evening lectures of public interest have been arranged at the Scripps Institution of Oceanography, according to a recent announcement. Evening lectures will be popular or semi-popular in character, while the afternoon lectures will be more technical. Lectures to be given include those by T. Wayland Vaughan and Burt Richardson.

The General Board of the University of Cambridge recommends that the following posts be established as from October 1 in connection with the Rockefeller Endowment for Scientific Departments: a university lectureship in cytology in the department of agriculture, a university lectureship in plant physiology and a university lectureship in mycology in the department of botany, an additional university lectureship and an additional university demonstratorship in the department of biochemistry. It is recommended that readerships in the university should be created for: Mr. F. T. Brooks, of Emmanuel College, in mycology; Dr. A. D. Imms, of Christ's College, in entomology, and Mr. James Gray, of King's College, in experimental zoology. A curatorship will be established to the Sedgwick Museum in the department of geology, and a senior curatorship and a junior curatorship of the Museum of Zoology will be established.

Fifty graduates of the U. S. Naval Academy are spending several weeks in plants of the Westinghouse Electric and Manufacturing Company, where several courses have been arranged for them. These include training for mechanical engineers specializing in turbine work and others who are primarily interested in Diesel engine practice. For electrical engineers, special stress will be put on electric ship propulsion and auxiliaries, both on shipboard and in navy yards. Metallurgists and civil engineers will have work in manufacturing processes and structures.

The first fish hatchery to be built by the U. S. Government as a part of its five-year building program will be constructed near Rochester, Indiana. The site, which was selected by the Bureau of Fisheries, is located at the outlet of Lake Manitou. Thirty such hatcheries will be constructed in various places in the United States.

According to a statement issued by the American Forestry Association, the United States Government has allotted to the Alabama Commission of Forestry $57,320 for the promotion of timber production within the state during the coming year. The funds are to be expended for forest planting and forest-fire protection. The amount allotted is approximately $4,000 more than that for the current year.

The *Museum News* reports that a standing commission on museums to act in a general advisory capacity has been appointed by the British Government. The commission is constituted as follows: Viscount D'Abernon, *chairman;* J. B Beresford, of the treasury, *secretary;* Evan E Charteris, Sir Richard Tetley Glazebrook; Lord Hanworth, the Earl of Harewood, Sir George MacDonald, Sir Henry A Miers, Charles Reed Peers, and Sir Philip Sassoon, M P The functions of the commission are (1) To advise generally on questions relative to the most effective development of the national institutions as a whole, and on any specific questions which may be referred to them from time to time, (2) to promote cooperation between the national institutions themselves, and between the national and provincial institutions, (3) to stimulate the generosity and direct the efforts of those who aspire to become public benefactors.

The Board of Control of Mental Health Services, with the approval of the British Minister of Health, has, according to a report in the London *Times,* appointed the following to advise the board upon questions arising in connection with scientific and ancillary mental health services Mr L G Brock, *chairman,* Sir Hubert Bond, Mr Robert Bruford, Mr W E Lovsey, Mr T S Good, Dr Adeline Roberts, Mr J C Grime, Professor J Shaw Bolton and Mr P Barter, *secretary* The mental treatment act, which came into operation on January 1, confers upon local authorities powers to provide for outpatient treatment and for the after-care of mental patients, and, subject to the approval of the Board of Control, to undertake or to contribute to research in regard to mental illness The Board of Control has appointed the advisory committee to assist them in the consideration of schemes of research submitted for the board's approval, and in regard to such questions as the organization of social services in connection with outpatient treatment and after-care, on which local authorities may seek the board's guidance On technical questions relating to research the advisory committee will have the expert advice of members of the Medical Research Council's committee on mental disorders

The personnel of the new Bureau of Agricultural Engineering of the U S Department of Agriculture, which was established about a month ago, includes many members of the former division of agricultural engineering S H McCrory is chief of the bureau, H. H Barrows is assistant chief, and K McSorley is secretary The new divisions are Irrigation, W W McLaughlin, chief, drainage and soil-erosion control, L. A Jones, chief, mechanical equipment, R B Gray, acting chief, structure, Wallace Ashby, chief, and plans and service, M C Betts, chief As special assignments in the bureau, C A Bennett is in charge of cotton-ginning investigations and G R Boyd, of farm-land development The editorial and information division is under R D Marsden, and the division of administration under G P Wolf S P. Lyle has been appointed in charge of extension activities and Mrs Dorothy Wilks, librarian

DISCUSSION

THE "RICKETTSIAE" AND THE INTRACELLULAR "SYMBIONTS"

Kligler and Aschner,[1] in an article on the "Rickettsiae" from certain blood-sucking pupipara, misunderstood my interpretation[2] of the intracellular bacteria found within the American and German roach. These authors, in discussing my work on these diphtheroids (p 113) state, "The mere fact that they are found in the insect cells is in our opinion no justification for classing them with the *entirely distinctive* group of Rickettsia." This, notwithstanding the fact that in their first sentence they state, "Rickettsia or rickettsia-like organisms have been studied extensively during the last decade; but there is as yet *no clarity as to the nature and precise definition* of this group of microbes" It will be noted in my work that both the terms "Rickettsia" and "Symbionts" were printed in quotes, and that much trouble was taken to demonstrate that the microorganisms discussed were indeed bacteria

Kligler and Aschner's point of view was anticipated, and for this reason, in 1930,[3] I discussed the whole question of the intracellular "Symbionts" and the "Rickettsiae" at length I still maintain that size and tinctorial properties alone do not constitute valid taxonomic characters and that a natural classification is based upon general biological relationships Creating new orders, families, genera and species without sufficient evidence is termed "splitting" by biologists and is considered extremely unconservative The most conservative workers always attempt to place new organisms within established systems

R W. Glaser

Department of Animal Pathology,
The Rockefeller Institute for
Medical Research,
Princeton, N J

---

[1] *J. Bacteriology,* 22: 103–114, 1931

[2] *J. Exp. Med.,* 51: 59–82, 1930; *ibid.,* 51. 903–907, 1930.

[3] *Archives of Pathology,* 9 71–96, 1930; *ibid.,* 9. 557–576, 1930.

THE CAUSE OF MOTTLED ENAMEL

MOTTLED enamel, a tooth defect first reported in the United States by Messrs G V Black and F S. McKay[1] in 1916, is wide-spread A recent Public Health Report[2] by Kempf and McKay shows mottled enamel to exist in districts in Colorado, Texas, Virginia, Arizona, Italy, Holland, China, Mexico, Spain, Argentina, Cape Verde Islands, Bahama Islands and other South American and South African countries Other centers have been reported recently in Illinois, North Dakota and Minnesota

Mottled enamel is usually characterized by dull white or "paper white" patches scattered irregularly over the surface of the tooth In some cases the whole tooth surface shows this dead white, unglazed appearance In many cases the enamel is badly pitted Mottled teeth probably erupt with the intercementing material absent They may or may not become stained later

From experiments in progress in the nutrition laboratory at the University of Arizona it appears evident that the causative factor of mottled enamel lies in the water supply of the afflicted communities, a view long since held by McKay By several lines of evidence in our laboratory the destructive action of the water upon the developing enamel of the teeth has been shown to be due to its content of flourine A condition resembling mottled enamel has been produced in the incisors of rats by the use of water obtained from St David, Arizona, an endemic community This water was reduced to one eighth of its original volume by evaporation and given to rats to drink Water residues were incorporated in the rations of other rats In both cases a defect of the teeth was produced which was similar, if not identical, to that condition produced in litter mates by the addition of sodium flouride to their ration The teeth were chalky white, and in many cases decidedly pitted An abnormal effect in the structure of rats' teeth produced by the feeding of sodium flouride was demonstrated in 1925 by McCollum and his coworkers,[3] but was not at that time associated with mottled enamel The incisors were reported to be abnormal in color, the orange tint normally seen on their anterior surfaces being nearly absent

Quantitative analysis of the water from St David and other afflicted communities has shown a high content of flourine as compared with but small amounts present in the waters of neighboring unaffected regions

Geologic relations to water supply are being investigated The finding of prehistoric animals of the late Cenozoic age (*mastodons*) the tusks and bones of which are unusually high in calcium flouride suggests a possible source of enrichment of the water in flourine in that community The deposit of cryolite (Na_3AlF_6) on Pike's Peak suggests the source of contamination of the water supply of Colorado Springs, another community in which mottled enamel is endemic

Gautier[4] has analyzed waters from many different sources for flourine and has shown that waters in volcanic regions, waters produced eruptively and so-called mineral waters contain higher concentrations of flourine

The relation between the degree of mottling and the concentration of flourine in the drinking water supply of humans is being investigated

There is some evidence in the author's laboratory to show that certain types of dietary inadequacies make the destructive action of flourine containing waters more pronounced

Work upon all these lines is being actively pursued

MARGARET CAMMACK SMITH
EDITH M LANTZ
H V SMITH

UNIVERSITY OF ARIZONA,
APRIL 27, 1931

RELIC OF AN EARLY AERIAL POST

QUOTING from the Encyclopedia Britannica, eleventh edition, vol 1, p 264

> The first balloon voyage across the English Channel was accomplished by Jean Pierre Blanchard (1753–1809) and Dr J Jeffries, an American physician, on the 7th of January, 1785 In their channel crossing Blanchard and his companion, who started from Dover, when about one third across found themselves descending, and threw out every available thing from the boat or car When about three-quarters across, they were descending again, and had to throw out not only the anchor and cords, but also to strip and throw away a part of their clothing, after which they found they were rising, and their last resource, viz, to cut away the car, was rendered unnecessary As they approached the shore, the balloon arose, describing a magnificent arch high over the land They descended in the forest of Guinnes

It may be added that a fine monument has been erected at the spot where they landed

On this journey from Dover Dr John Jeffries wrote a card to his friend, Mr Thayer, and dropped it before passing from the English coast This yellowed and stained bit of early aerial post has recently come into the possession of the Snell Museum of

---

[1] G V Black and F. S McKay, "Mottled Teeth," *Dental Cosmos*, June 16, 1916

[2] G A Kempf and F S McKay, "Mottled Enamel in a Segregated Population," *Public Health Reports*, 45, p 2923, 1930

[3] McCollum and coworkers, "The Effect of Additions of Flourine to the Diet of Rats on the Quality of Their Teeth," *Jour. Biol Chem*, 63 · 553, 1925.

[4] A Gautier and P Clausmann, "Le Flour dans les Eaux Minerales," *Compt Rend. Acad.*, 158 1631, 1914.

Physics at Amherst College It was presented to the college many years ago by Thatcher Thayer, D D , of the class of 1831, Amherst, a descendant of the Thayer to whom it was originally written

The post-card was written with a lead pencil, and is fairly legible except for a stain in one corner. The inscription is as follows·

> From the Balloon above the Clouds
>
> Let this afford one proof, my dear Mr Thayer, that *no separation shall make me unmindful of you*,—have confidence,—hopeful that happier days are in store for you, my dear Mr T I wish you much pleasure,—believe me as I ever have been,
>
> faithfully yours,
>
> J Jeffries

This little bit of post-card was prophetic of the days when the Wright brothers' "Strange Contraption" should rise at Kitty Hawk in 1903, when Louis Blériot, 1909, should drive an aeroplane from France to the white cliffs at Dover, when aeroplanes and dirigibles should become the speedy carriers of our mails and when we should see

> the heavens fill with commerce,
> argosies of magic sails,
> Pilots of the purple twilight,
> dropping down with costly bales

S R Williams

Amherst College

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE ABDOMINAL WINDOW

Simplification of methods and apparatus in experimental procedures is a goal that is earnestly sought after in teaching Too frequently, however, when the goal is attained, the results are disappointing In our laboratory we have devised a piece of apparatus in our teaching courses which has several attractive features that are of interest to teachers, especially those who must combine economy with success The abdominal window is simple in construction, the results are gratifying, and the expense is almost nothing There have been many methods devised for observing the movements of stomach and intestines in anesthetized animals, *e g*, submerging the intestines under saline solution with the abdominal wall open and making direct observations, feeding a meal mixed with material opaque to x-ray and observing the contractions of the intestines on the opaque material, opening the abdomen in the midline and inserting a watch-glass under the abdominal muscles but over the intestines, opening the abdomen and without further preparation observing the movements as long as they last Those who have used the above methods will recall readily certain vital objections to each method especially for use in class work

The abdominal window which we have been using since 1922 in our laboratory is not a new principle but a modification which has proved very successful here. The method was demonstrated at the meeting of the Federation of American Societies for Experimental Biology at Chicago in March, 1930. The window is a modification of the old watch-glass method. One of the most annoying features with that method was the tendency for a loop of intestine to move out of the field of observation, especially after normal observations had been obtained and a procedure inaugurated whose effect one wished to observe The watch glass was easily placed, but the results were too frequently disappointing We felt that a larger field of observation should be provided in order to obviate the disappearance of a particular loop of intestine in which we had become interested

The abdominal window which we have developed is shown in Fig 1 It consists of a piece of old x-ray film (A) which has had the coating removed and which was cut in the shape shown It is 7″ long, 4½″ wide This has been found to be a satisfactory size for both cats and rabbits We have used it mostly in rabbits. In the upper third is cut a hole 1¼″ in diameter and centered laterally A lid or door (B) is then cut from another piece of film of such size and shape that it may effectually close this opening or expose it when swung on the hinge (C) This hinge is made with an ordinary office combination punch and eyelet machine. Near the outer margin of the lid (about ⅛″) a slit is cut just wide enough to permit the insertion of one jaw of a No 46 Dennison card holder (E) This clip insures the lid being fastened shut Release of the clip permits the opening of the hole in the window Woven back and forth through the lid is a wire (D) which is bent slightly with its concavity downward We used the wire of a No 1 paper clip straightened out. The object of this wire is to prevent the lid from curling up laterally when it becomes warm The Dennison clip and the hinge prevent curling in its long diameter. The object of the lid is to permit the making of injections directly into the loop of an intestine or to make applications of agents directly on the outside of the intestinal tract.

The placing of the abdominal window requires a little more operative procedure than the watch glass,

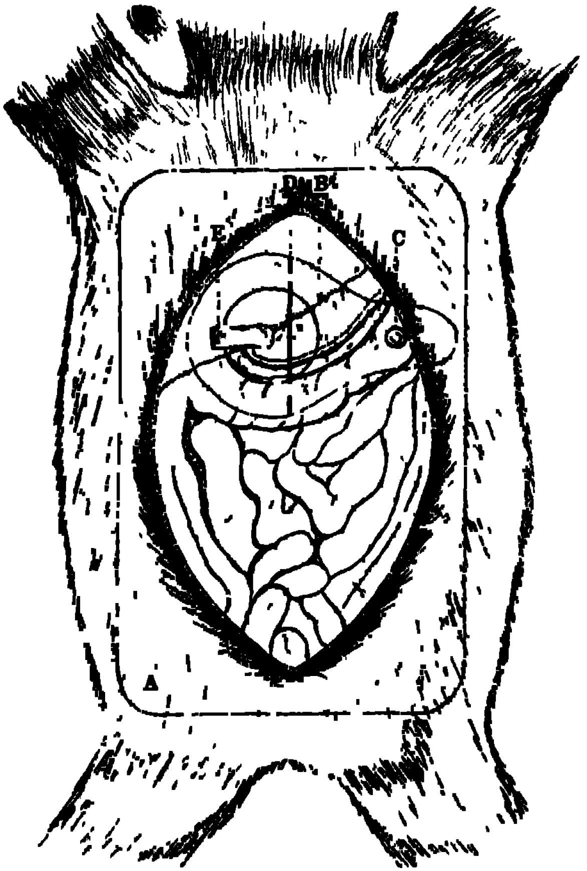


Fig. 1. The Abdominal Window in Place
(Semi diagrammatic.)

but the returns in successful observations more than counterbalance the extra work. We have used the following technique. After thorough anesthetization with urethane or other anesthetics, a median abdominal skin incision is made two inches less in length than the abdominal window. The skin is then separated from the underlying muscles, the *separation* extending one inch *beyond each end* of the lineal incision in the skin and laterally almost to the spinal column. This is fairly easily accomplished in the rabbit, not so easily in the cat, and more difficult and bloody in either animal if it is a female, because of the mammary glands.

The skin having been thus thoroughly separated, a double row of ligatures is laid through the muscles of the upper abdomen in a line at right angles to the long axis of the animal's body, and the muscles cut across between the ligatures. A similar double line of ligatures is laid across the lower abdomen and the muscles cut between them. Care should be taken of course that the underlying intestines or bladder are not included in the ligatures or injured. We use eight ligatures in the upper abdomen and four in the lower abdomen. Each ligature extends over an inch or one and one half inches, and includes a fairly large mass of muscle tissue. Technique of preparation, however, may be varied to suit one's personal inclinations. The muscles then are separated longitudinally by an incision made in the median line. Then they are rolled back on either side from the median line, thereby exposing a large field to view. A loose ligature may be laid under one of the loops which will be under the opening in the window.

The abdominal window is then placed *under* the skin, but *on* the abdominal muscles which have been rolled back. With the lid of the window open, the loose ligature, previously placed under a loop of intestine, may be drawn up through the opening and left outside. The lid is then closed and fastened by means of the Dennison clip. If the large intestine occupies too much space in the center of the field (especially in rabbits), it may be moved to one side before the window is placed.

In a few minutes after placing the window, it becomes sealed from the skin oozing and so is practically air-tight. The small amount of air that may enter through the lid is of no consequence, as movements continue uninterruptedly. No fluid is required to be placed in the abdomen. Fog may collect on the under surface of the window and is due to the unequal temperature of the room and the inside of the abdomen. This may be obviated by keeping hot moist towels laid over the window between observations. Whether fogging occurs or not, it is a good plan to keep hot towels laid over the window especially in a cool laboratory for, unless the animal is on a heating pad, its temperature tends to drop rapidly because of the thin window, and therefore the intestinal movements may be much retarded or stopped altogether.

The advantage of this method is the large field for investigation and the ease of making the observations. A loop of intestine does not depart from the field of observation at the most inopportune moment. Furthermore, it is an easy procedure to secure a loop of intestine and bring it up where a hypodermic needle may be inserted into the lumen and injections made in that manner. The loop is then returned inside the abdomen and the lid closed. In the same manner applications directly to the outside of the gut may be made. Properly insulated wires may be introduced through this opening and stimulations of nerves or muscles made directly. The method is admirably adapted not only to the observation of intestinal movements, but also for the observation of the condition of the blood vessels, *i.e.*, whether dilated or contracted; and for observations of other abdominal organs, such as bladder, uterus, kidneys, etc.

While the method was devised primarily for teaching and demonstration purposes, it may be used in research, and in the physiological laboratory of this school Dr Leland C Wyman has carried on an investigation in which he made use of the window to observe vascular changes in the intestines of a rat

The abdominal window herein described is simple, efficient, inexpensive, and has the added advantage that it maintains the interest of students because they are able to carry on their experiments easily and successfully

Walter L Mendenhall
Boston University School
of Medicine and the
Evans Memorial

A METHOD FOR RIPENING HAEMATOXYLIN SOLUTIONS RAPIDLY

The writers are calling the attention of biological workers to the ease in preparation of various haematoxylin solutions which ordinarily require a rather long ripening process Within our knowledge, this method has not been reported heretofore Ehrlich's or Delafield's haematoxylin solutions are prepared in the usual way When ripening is to be brought about, the solution is placed in a very wide and somewhat shallow evaporating dish and exposed at a distance of approximately two feet, to any rather powerful quartz mercury vapor light The rapidly darkening solution should be stirred frequently Delafield's solution will be ready for use after an exposure of about two hours, and some three or four hours are necessary for ripening Ehrlich's solution. A very vigorous staining solution results This method can also be applied to the ripening of a one half per cent haematoxylin solution for use in Haidenhain's iron-alum stain except that the exposure to the quartz mercury arc is very much shorter

E J Kohl
C M James
Department of Biology,
Purdue University

SPECIAL ARTICLES

SEXUAL RHYTHM IN THE CALIFORNIA OYSTER (OSTREA LURIDA)

It has been known for many years[1] that the common edible oyster of our Pacific coast is hermaphroditic and viviparous but no definite information has been hitherto available as to the sequence of the sexual phases in this species With the cooperation of Professor W E Allen, of the Scripps Institution of Oceanography, cement and wooden experimental blocks have been placed in the water at frequent intervals and at all seasons during the past five years From these blocks, which were suspended from the Institution's pier at La Jolla, California, a fairly complete series of oysters of approximately known ages has been obtained.

Weekly or biweekly collections were made, at which time one face of a block was scraped free from attached organisms, including oysters The block was then returned to the water to gather a new crop of the free-swimming stages of such organisms as were at that time ready for attachment

Examination of such blocks shows that the oyster in that locality is in process of reproduction during at least seven months of the year,[2] or for a longer period in those years in which the water remains unusually long above the critical temperature of about 16° C. in the autumn or reaches this temperature earlier than usual in the late winter or spring For it is found that spawning is inhibited when the water falls below this temperature, to be resumed when the critical point is again reached

Microscopic sections of the gonads show that some members of the oyster population in that locality have ripe sexual products at all seasons of the year and that all possible combinations of sexual phases are represented Immature individuals in the male phase, young hermaphrodites, inter-sexual forms predominantly of one sex or of the other, with all conceivable transition stages, are always to be found, as Stafford has long since reported[1] Some of these are evidently young, others are mature and still others are obviously old, but they offer only vague testimony as to the sexual conditions appertaining to any one individual during its lifetime By taking a series of oysters of definitely known ages, on the other hand, such as has become available from these experimental blocks, the sequence of sexual phases can be followed with little chance of error

In the young animal the first trace of the gonad appears at the age of about eight weeks The few cells composing this gonad show no distinguishing characteristics of sexual differentiation, but at the age of twelve to sixteen weeks each gonad in every animal studied shows that both primitive ovogonia and spermatogonia are present

The spermatogonia, however, proliferate more rapidly than do the ovogonia and the gonad soon acquires the characteristics of a spermary, although ovogonia and ovocytes are always present. Spermatogenesis quickly follows if the temperature is sufficiently warm and the ripe spermatozoa are ready to be discharged when the oyster is about five months of age.

---

[1] Jos. Stafford, The Canadian oyster *Comm. of Conservation*, Canada, pp 1–159, 1913.

[2] W. R. Coe, *Anat. Rec.*, 47: 359, 1930

This is typical protandry, and this evidently occurs in all individuals, for no exception has been found. The spermatozoa are held firmly together in spherical masses, the so-called sperm-balls, each ball consisting of from about 250 to 2,000 or more ripe spermatozoa, all of which have been derived from a single primary spermatogonium. Before this initial male phase has been completed and before any of the sperm-balls have been discharged, the proliferation of the ovogonia and their transformation into ovocytes is in progress. Most of the sperm-balls are then discharged from the body, whereupon the animal assumes the first female phase, although some sperm-balls are always left in the genital ducts, and many spermatogonia for the subsequent male phase are present in the gonads.

In the early female phase the original primary gonads increase greatly in size by the growth of the ovarian tubules into the underlying connective tissue, forming the secondary gonads. In these tubules the ovocytes build up their yolk materials and at the age of about six months the climax of the first female phase is reached. Ovulation then occurs, the eggs being retained in the mantle cavity of the parent during fertilization and cleavage and through development until the embryos have become provided with a bivalved, straight-hinged shell—a period of approximately ten to twelve days, perhaps. It seems not improbable that ovulation takes place only when the animal is stimulated by the presence in the water of spermatozoa of other individuals, as Galtsoff[3] has found to be the case in other species.

In the process of ovulation the eggs frequently mingle in the genital ducts with the sperm-balls remaining from the preceding male phase, but self-fertilization can not occur, at least not until the gametes have reached the sea water in the mantle cavity, for the spermatozoa are only liberated by the solvent action of the water on the substance of the sperm-ball. Even then there is no evidence that self-fertilization takes place, for it is not known whether the gametes from the same individual are mutually reactive.

Not all the ripe ova are discharged at the first ovulation. Those remaining in the gonads may be absorbed by phagocytosis, or a second ovulation may occur as soon as the first crop of larvae has been spawned. Many other ova, evidently not quite ripe, are retained to form the basis for the second female phase.

While the embryos are developing within the mantle cavity the spermatogonia remaining in the gonads begin a rapid spermatogenesis and even by the time the embryos have been spawned the second male phase has been reached. The number of sperm-balls produced is now vastly greater than in the first male phase and a much greater proportion of them contain the maximum number of spermatozoa. If the animal is well nourished some hundreds of thousands of such sperm masses are formed, with upwards of 2,000 spermatozoa in each.

Given the suitable stimulus, most of the sperm balls will be discharged, a few remaining as before. The body of the oyster has then become soft, flabby and translucent, presenting a marked contrast to its plump whitish condition preceding the discharge of the gametes. A period of recuperation follows. The body grows larger and nutrient materials are then stored in the tissues in preparation for the following sexual phases. The time required will evidently depend upon the metabolic conditions of the animal.

Examination of the gonad during this resting period shows the preparation for a second female phase. When completed, if the environmental conditions are suitable, a new crop of embryos will appear in the mantle cavity, and coincidentally therewith the proliferation of spermatogonia for the third male phase. Following the ripening and discharge of the sperm will come another recuperation period. And, apparently, these alternating sexual phases may be repeated regularly throughout the remainder of the animal's life. But it is not at all improbable that in certain individuals, and possibly in some hereditary strains, one sexual phase or the other may be considerably reduced in older animals, with a corresponding tendency toward a dioecious condition. It is also not unlikely that in the colder portion of the range of the species a single annual rhythm or even a biennial rhythm may be found to occur, as is the case with the European oyster in some localities.[4, 5, 6]

Following the initial male phase, we thus find in the California oyster a regularly repeated sexual rhythm in (*a*) female, (*b*) male and (*c*) recuperation sequence for each individual. The conclusion follows that the fertilized eggs are all alike in regard to their primary sexual inheritance, with an associated hereditary mechanism, perhaps metabolic in nature, which is responsible for the rhythmical alternation of the sexual phases. Environmental conditions determine the rate of the sequence, and the time occupied by each of the successive phases, but there is as yet no evidence that the sequence is altered.

---

[3] P. S. Galtsoff, *Proc. Nat. Acad. Sci.*, 16: 555–559, 1930.

[4] P. P. C. Hoeck, *Tids. Nederl. Dierk. Ver.*, Deel 1, Suppl., 113–253, 1883–4.

[5] R. Spärck, *Rep. Dan. Biol. Sta.*, 30: 1–84, 1925.

[6] J. H. Orton, *Jour. Mar. Biol. Assoc.*, 14: 967–1045, 1926–7.

This statement needs to be qualified by the additional remark that the rhythm may be interrupted at any point by the advent of low temperature and presumably by any unfavorable metabolic conditions, to be resumed again when a suitable environment is restored

It must be remembered that spawning occurs on the coast of Southern California during seven or more months of the year, so that on approach of cool weather the population will be represented by individuals which are in all stages of growth and reproduction, from larvae to old adults. Growth continues below the critical temperature but the discharge of sexual products is inhibited The phase in which the animal enters this period will be retained throughout the winter unless the time of inhibition happens to coincide with the completion of one of the sexual phases

A further complication results from the fact that not all parts of the reproductive system reach any one phase of sexuality at the same time, so that we shall find one portion in a somewhat different phase than is another area in the same animal And finally, there are all grades of intersexuality as one phase passes into the next This is particularly true of the younger animals, there being no exclusively male or female individuals among them at any season

With increasing age, however, the intergrading stages become reduced and the sexual phase may be occasionally strictly male or female except for the minute gonia which anticipate the next phase But in nearly all cases a few sperm-balls remain in some part of the system through the female phase and, conversely, a few ovocytes in the male phase recall the preceding part of the rhythm or foretell the next.

We may conclude, then, that *Ostrea lurida*, like the European *O edulis*,[4,5,6] is a protandric hermaphrodite, with an alternating rhythm of female and male phases throughout life[7,8]

WESLEY R. COE

OSBORN ZOOLOGICAL LABORATORY,
YALE UNIVERSITY

[7] Of some sixty species of the genus *Ostrea* ten are known to be monoecious In some of the others hermaphroditism has been found in young animals or in some localities, while in one species, classed as dioecious, a considerable proportion of individuals have recently been shown by Amemiya (*Proc. Imp Acad. Tokyo*, 5: 284–286, 1929) to change their sex during the winter

[8] In a recent number of SCIENCE (74. 71, 1931) Burkenroad presents evidence that even *O virginica* on the coast of Louisiana is protandrous, with an incidence of hermaphroditism of about 1 per cent. in the general population. The writer has also found a considerable percentage of intersexuality in small individuals of the same species at Woods Hole, Massachusetts.

RICE BRAN, A PREVENTIVE OF PEROSIS (DEFORMING LEG WEAKNESS) IN CHICKENS[1]

IN the fall of 1929 the animal husbandry division of the Bureau of Animal Industry and the departments of poultry husbandry of several Southern and Southwestern state agricultural experiment stations organized an informal cooperative project for the purpose of comparing, on a weight-for-weight basis, different feeding stuffs when included in a so-called "uniform" diet for growing chickens During the spring and summer of 1930 the following experiment stations used the "uniform" diet in some of their feeding experiments with growing chicks: Kansas, Louisiana, New Mexico, Missouri, Texas, the U S Poultry Experiment Station, Glendale, Arizona, and the U S. Animal Husbandry Experiment Farm, Beltsville, Maryland

Several of the stations reported that when the "uniform diet" was fed to chicks kept in confinement a high percentage of them became afflicted with perosis (deforming leg weakness) One of the writers (W M G), observed, however, that when 10 and 20 per cent. of rice bran replaced equivalent amounts of wheat in the "uniform" diet, no cases of perosis occurred Soon after this observation was made, the other writer (H W T) started a series of experiments for the purpose of studying the cause of the beneficial effect of rice bran in preventing this condition

The results of these experiments are now being written up for publication Since perosis, or leg weakness, has been a serious obstacle to the rearing of chickens in confinement, it seems to be advisable to call attention, at this time, to some of the conclusions drawn from these experiments

Perosis, or deforming leg weakness, in chickens is a condition of dietary origin, in which the legs become deformed in various ways The first observable symptoms are a slight puffiness of the metatarsal-tibia joints and a marked tendency on the part of the chicks to rest for long periods of time in a squatting position with the legs doubled up under them As the condition becomes worse, the joints become more enlarged and a pronounced bending of the tibiae and tarsometatarsi may occur Union of the diaphyses and epiphyses at the distal end of the tibiae is greatly delayed, or fails to occur. Sometimes there is a marked separation of the epiphyses from the diaphyses and the large tendons slip from their condiles leaving the metatarsal-tibia joints permanently deformed.

---

[1] Published with the permission of the director of the Louisiana Agricultural Experiment Station and the chief of the Bureau of Animal Industry of the U. S. Department of Agriculture.

This condition can be partially prevented by (1) adjusting the calcium-phosphorus ratio of the diet to a more suitable value, and (2) by adding from 6 to 10 per cent. of rice bran to the diet. When both of these changes are made simultaneously, it is possible to prevent the condition entirely. In the presence of 6 to 10 per cent. of rice bran, a dietary calcium-phosphorus ratio of 2.5:1 was found to be effective in preventing perosis.

It seems probable that in the past this condition has often been confused with rickets. That the condition is not a truly rachitic one is indicated by the following observations: (1) The ash content of the leg bones may be, and nearly always is, normal, and (2) the calcium and inorganic phosphorus content of the blood serum falls within the normal range.

In view of the experimental findings it seems necessary to postulate that, in addition to vitamin D, another accessory food factor, or vitamin, is necessary for the proper development of the leg bones (and possibly of the other bones) of the growing chicken. It is suggested that water-alcohol extracts of rice bran may be of value in treating refractory cases of rickets in human babies, when there is little or no response to treatment with viosterol, or cod-liver oil, alone.

Harry W. Titus
W. M. Ginn

Bureau of Animal Industry,
U. S. Department of Agriculture,
Louisiana Agricultural Experiment
Station

THE FORMATION OF GLYCINE FROM SERINE[1]

In a recent paper, Daft and Coghill[2] have recorded the isolation of glycine in 28 per cent. yield from the vigorous alkaline hydrolysis of another naturally occurring amino acid, serine. While the reaction may appear anomalous, it is readily explained on the basis of a theory which the writer is finding useful for the explanation of the sensitivity toward alkalies of cysteine and its derivatives.

The reaction

$$\text{(A)}\ \mathrm{R'CHO + H_3CC(=O)R \rightleftarrows R'CH(OH)CH_2C(=O)R \rightleftarrows R'CH{=}CHC(=O)R + H_2O}$$

is very well known, as is the fact that all its stages are reversible, the various changes being powerfully catalysed by alkalies.

Glycine, $H_2NCH_2C(=O)OH$, is a substance which contains, at least formally, the same groups as the methyl ketone of equation A. It is generally recognized that the carboxyl group is much less, though not indefinitely less, active in the respects here discussed, than the keto group. Nevertheless, reactions analogous to those indicated in equation A take place with glycine when it is substituted for the ketone represented in that equation. As a good example, the customary synthesis of β-phenyl serine[3] from benzaldehyde and glycine may be mentioned.

In the writer's opinion, the formation of glycine from serine as described by Daft and Coghill is only a reversal of this reaction:

$$\text{(B)}\ \mathrm{H_2C(OH)CH(NH_2)CO_2H \rightarrow H_2CO + H_2C(NH_2)CO_2H}$$

It is perhaps worth while, in this connection, to call attention to the fact that methylenemalonic ester, $H_2C{=}C(CO_2C_2H_5)_2$, needs no stronger alkali than ammonia to give[4] a formaldehyde derivative (hexamethylenetetramine) and malonamide. This reaction, in which hydroxymethylamalonic ester is undoubtedly an intermediate, is quite analogous to that described for serine, but occurs under much gentler conditions, due presumably to the greater activating effect of two carboxyl groups, and to the fact that the latter are in this case esterified.

It may be added that when cysteine is hydrolyzed with alkali, no formation of glycine has as yet been observed. The reaction takes instead the other course suggested by equation A, and hydrogen sulfide is split out[5] in the first of a series of reactions. A strictly analogous reaction, with loss of water, apparently accounts for the major portion of serine when the latter is similarly treated.

Ben H. Nicolet

Beltsville, Maryland

BOOKS RECEIVED

Bogert, L. Jean. *Nutrition and Physical Fitness.* Pp. 554. 65 figures. Saunders. $3.00.

Hegner, Robert W. *Practical Zoology.* Revised edition. Pp. xvi + 561. 332 figures. Macmillan. $1.80.

Kyoto Imperial University. *Memoirs of the College of Science.* Series B. Volume VI, No. 1, Pp. 51, No. 2, Pp. 53–108, No. 3, Pp. 109–160. Illustrated. The University.

McSpadden, J. Walker. *To the Ends of the World and Back.* Pp. xv + 362. 59 illustrations. Thomas Y. Crowell. $3.00.

Perrier, Georges, editor. *Travaux de la Section de Géodésie de l'Union Géodésique et Géophysique Internationale.* Tome 7. Fascicule 1. *Rapports Nationaux sur les Travaux Exécutés dans les Différents Pays.* Illustrated. The editor, Paris.

Tôhoku Imperial University. *Science Reports.* Second Series. *Geology,* Volume XIV, No. 2, Pp. 133. Illustrated. The University.

---

[1] From the Bureau of Dairy Industry, United States Department of Agriculture.

[2] *Jour. Biol. Chem.*, 90: 341, 1931.

[3] E. Erlenmeyer, Jr., *Ann. Chem.*, 337: 245, 1904.

[4] A. Kötz, *J. prakt. Chem.*, (2) 75: 506, 1907.

[5] H. T. Clarke and J. M. Inouye, *Jour. Biol. Chem.*, 89: 399, 1930.

SCIENCE

Vol 74 | Friday, September 11, 1931 | No 1915

Poliomyelitis (Infantile Paralysis) Dr Simon Flexner 251

Genetics and Evolution Professor Maurice Caullery 254

Scientific Events
The International Conference on Bituminous Coal, Paintings of Prehistoric Life at the Field Museum of Natural History, County Health Departments, The Beit Memorial Fellowships for Medical Research 260

Scientific Notes and News 262

Discussion
Submerged Peat Beds among the Apostle Islands Frank B Taylor *North American Phyllopods* Edwin P Creaser 265

Scientific Apparatus and Laboratory Methods
A Technique for Fixing and Removing Chick Blastodiscs and Embryos from the Egg Shell Mark M Keith *A Heating Humidifying Device for Incubators* George Wishart and A B Baird 268

Special Articles
Combination of Bacterial Polysaccharides and Collodion Particles as Antigens Dr José Zozaya *Lignin as a Nutrient for the Cultivated Mushroom, Agaricus Campestris* Professor Selman A Waksman and W Nissen 270

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D C

POLIOMYELITIS (INFANTILE PARALYSIS)

By Dr SIMON FLEXNER

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK, N Y

The essential nature of infantile paralysis has been determined within the twenty-year period during which the disease, escaping from its endemic home in Norway and Sweden, has made its epidemic progress over the world Only the tropics, and even they not wholly, have been spared its ravages

It is probably just because infantile paralysis had never before prevailed in a world-wide epidemic that we are witnessing the periodical outbreaks which are so tragic in their consequences On the whole, the outbreaks have been larger and more severe in North America than elsewhere and for reasons, as will appear, which are bound up with the nature of the disease

Infantile paralysis is a disease long known to physicians, although its infectious and communicable nature was established only about forty years ago during an epidemic in Stockholm Hence it is known to be a disease of microbic origin The microbe or microorganism which induces infantile paralysis is so minute that it is not certain that it has ever been seen under the microscope Because of its minuteness, it can pass through filters of earthenware which hold back, and prevent from passing, ordinary microorganisms, such as the bacteria

The microbe of infantile paralysis differs in another way from the usual bacteria While bacteria are easily made to grow outside the body, the microbe can be made to multiply in this way only under special conditions These conditions are provided by growing and multiplying tissue cells taken from warm-blooded animals and propagated in tissue cultures. When the invisible microbe of infantile paralysis is cultivated with tissue cells, both increase together, the microbe probably within the cells.

There are many other kinds of invisible microbes which produce diseases of plants and the lower and higher animals The microbe of infantile paralysis belongs to this class of ultraminute living bodies All these ultramicroscopic disease-producing microbes share the peculiarity that in order to be made to multiply outside the animal or plant which they attack as parasites, and in which they cause disease, they must be cultivated with living and growing tissue cells

Certain pathologists have expressed skepticism about the microbe of infantile paralysis because of its invisibility and the difficulty of making it increase outside the body This would be equivalent, let us say, to denying the existence of atoms because they also are beyond visibility and can not be made to increase at all by any means known to us at present Now, physicists and chemists are not doubtful about the atom because of certain known properties concerning it These properties enable physicists and chemists to experiment with the atom and to learn a vast number of things concerning its nature through the experiments They are in no essential way hindered from acquiring this knowledge because of the minute size of the atom In a very similar way pathologists have dealt and are dealing successfully with the invisible microbes of disease and prominently among them the microbe of infantile paralysis A vast amount of new knowledge of infantile paralysis has been obtained by experiment since the microbe was discovered in 1910 simultaneously at the Rockefeller Institute in New York and the Pasteur Institute in Paris

The control of any communicable disease is greatly promoted by the discovery of the mode of infection or the way in which the microbe enters and leaves the affected body The epidemic in Stockholm and its environs in 1905 led to the recognition that infantile paralysis was passed from person to person. But just how this passage took place could be conjectured but not definitely determined at the time

With the discovery by Dr Landsteiner in 1909 of the communicability of infantile paralysis to monkeys the way was suddenly opened to the detection of this essential fact and many other important facts regarding the disease which have since been brought to light The first step forward consisted in the discovery at the Rockefeller Institute that the microbe of infantile paralysis escapes from the body in the secretions of the nose and throat. It is not as widely appreciated as it should be that a way for the disease-producing microbe to escape alive and undamaged from the body is just as essential for the spread of the disease as a way of effectively entering a healthy individual in whom disease is to be produced Hence the detection of the manner and place of exit of the microbe may afford the clue as to its means of entrance. And this is actually what happened in the instance of poliomyelitis Finding that the microbe escapes by way of the nose and throat led almost immediately to the discovery that it was able also to enter the healthy monkey and induce paralysis through these organs This knowledge led in its turn to the detection of the microbe in the secretions of the nose and mouth of children suffering from infantile paralysis and also in these secretions of persons—parents especially—who have been in intimate contact with the sick children

At the present time it is the firm belief of most pathologists that the microbe of infantile paralysis is carried from person to person, from the infected to the uninfected, through the secretions of the nose and throat The public health measures designed to reduce the spread of the disease are based on this belief. All this does not mean that there may not be still other ways of communicating the disease yet to be discovered. It is known, for instance, that the microbe of infantile paralysis can be spread by milk Two small, isolated outbreaks of the milk-borne disease have been detected in New York State within a few years These epidemics differ from the usual ones in their restricted extent and almost explosive character The cases tend all to arise in rapid succession, after which there is complete or nearly complete cessation A few days or a week or two witness the entire progress of these outbreaks

One attack of infantile paralysis, no matter how slight, usually affords protection for life Associated with this state of immunity, and responsible in part, if not wholly, for it, is the presence in the blood of a substance which, when inoculated into monkeys, is capable of preventing the microbe from producing the disease The serum of the blood, or its fluid portion separated from the corpuscles, is equally effective, and it is capable, not only of rendering the microbe inactive when the two are mixed in advance, but, also, as was discovered at the Rockefeller Institute in 1910, of preventing the onset of paralysis in monkeys when the microbe is first introduced and the serum from recovered human beings or monkeys is injected 24 to 48 hours later

This observation is the experimental foundation for the convalescent serum treatment of infantile paralysis which, first applied in man by Professor Netter of Paris in 1911, has now come to be widely employed. The extent to which the serum treatment is effective has still to be determined with accuracy. It is now known not to be of value when paralysis has already occurred. On the other hand, it is believed that the earlier the serum is administered after symptoms appear the better the results obtained.

Not only are the protective and curative properties present in the blood of persons who have recovered from obvious attacks of infantile paralysis, they are present also, in some amount, in the blood of many adult persons who have never suffered from the disease This is not peculiar only to infantile paralysis Many affections of microbic origin exist in two forms one in which disease is frankly present; the other in which individuals exposed to the microbe harbor it for a time during which no symptoms of disease occur, but immunity to the microbe is secured This is true of such common microbic diseases as diphtheria and scarlet fever, which may be cited as examples of a larger class That the blood serum of normal adults renders the microbe of infantile paralysis inactive was noted by Anderson and Frost, of the U S Public Health Service, in 1911 Subsequent studies on a larger scale, carried out by the Harvard Poliomyelitis Commission under Dr Aycock, have shown that this sort of unperceived immunization is taking place widely to-day in the United States It is to this protective process, perhaps, that we have to look finally for the eradication of poliomyelitis from this country It is probable that the reason northern America has suffered disproportionately from the disease in the past 20 years is that the general population, not having been exposed over a term of years as have many of the European populations, lacks the immunity conferred by the unperceived carriage just described of the microbe of infantile paralysis.

We gain a strengthened impression of this kind of protective mechanism at work in the dark by studying the age frequency of the disease and comparing the frequency with the ages at which the blood protection is demonstrable. In childhood, up to the tenth year, there is little protection discernible; this is the period of greatest frequency of the disease. From ten years on the protection rises and the frequency of the disease diminishes. In adults the protection reaches maximum and the cases minimum figures. The proportion of protected adults increases with the opportunity for exposure to the microbe, hence it is higher in urban than in rural communities. The ages of the children who are now suffering most in the New York epidemic conform to this rule. Indeed, with minor exceptions, the victims of the present epidemic have been born since 1916; far more children under rather than over ten years of age have been stricken

The employment of convalescent serum for the treatment of early cases of infantile paralysis was begun in 1911. In 1916 Zingher, of the Department of Health of New York City, employed the serum of normal adults for treatment The logic of this procedure is apparent from what has been stated concerning the antimicrobic powers of the blood of many adults. Probably the concentration of the curative substances is greater in convalescent serum, but this need not always be the case. In the absence of supplies of convalescent serum, normal adult serum may be employed for treatment It is advisable to combine the serum of a number of individuals, rather than to rely on that of a single person, in order to increase the probability of administering an effective dose

The convalescent serum has been shown experimentally not only to exert curative (therapeutic) properties but to possess preventive powers as well Definite observations on this point, having as object a possible application to protective serum injection, were made at the Rockefeller Institute in 1928 At this time attention was directed to the employment of convalescent serum for prevention in an emergency Fortunately, the case frequency of infantile paralysis is not high, so that resort to this measure will not often become necessary Moreover, so far as convalescent serum is concerned, in an emergency the available supplies will be required for the treatment of declared cases On the other hand, abundant supplies of normal adult blood are always procurable In view of the high proportion of adult city dwellers who are immune, the blood serum of parents or other suitable persons can readily be administered to younger children who are exposed to infection No assurance of absolute protection can, of course, be given, but, by analogy with measles, benefit may be hoped for or even expected Time and experience alone will make it possible to ascertain the value of this procedure.

The obvious effect of an attack of infantile paralysis is paralysis of the muscles The microbe does not act on the muscles directly but indirectly through nerve cells presiding over the muscular movements and located in the spinal cord chiefly These cells are acted on directly by the microbe and injured, sometimes the injury is so severe that the cells are destroyed outright, sometimes the injury is severe enough to interrupt function for a time only. In the one case the muscular paralysis is permanent, in the other restoration of function occurs The microbe acts also on the cells and tissues about the nerve cells; the disturbance thus produced affects indirectly the function of the nerve cells When these indirect effects disappear, with recovery from the disease, renewal of function of the nerve cells and muscles takes place. Time is often required for the complete reversal of the general cell and tissue disturbances during which restoration of muscular power slowly returns. There is a great diversity in the extent and location of the injurious effects of the microbe, and there is very great variation in the intensity of the action exerted so that muscular paralysis, when present, may be slight or extensive, fleeting or permanent The extent of the paralysis at the beginning of the attack is no accurate measure of its endurance Recovery from paralysis on a wide scale is not only possible but often takes place

RECAPITULATION

The microbe of infantile paralysis is known to belong to the class of invisible, filter-passing microorganisms to which the name of viruses is applied

This virus has been found in the secretions of the nose and throat of persons ill of infantile paralysis and of well persons in intimate contact with the sick

When the virus is applied to the nose and throat of monkeys it passes along the connecting nerve fibers to the brain and spinal cord and induces paralysis similar to that occurring in the human disease

That communication of the disease from person to person is brought about by personal contact and the transfer of the secretions of the nose and throat of the sick to the well has been established by observation of human epidemics and by experiments on monkeys Whether or not any other common manner of communication of the disease to man exists is not known Present public health measures of control of infantile paralysis are based on this mode of personal infection

An attack of infantile paralysis is protective for life, irrespective of the intensity of the attack

Persons who have had infantile paralysis possess in their blood certain protective or healing substances which can be used effectively to treat persons sick of the disease, and perhaps to prevent the disease in other and exposed children It is the fluid portion of the blood that is employed in this way under the name of convalescent serum

Since many normal adults develop immunity to infantile paralysis as a result of exposure to the virus under circumstances not leading to obvious disease, their blood serum also carries, at times, the protective and healing substances The serum of these adult persons, which is abundantly available, may sometimes be substituted for the serum of convalescents, which is necessarily limited in quantity

There are strong reasons for believing that a gradual immunization of the population of the United States is taking place as a result of the epidemics of infantile paralysis which have prevailed in different parts of the country since the large Swedish-Norwegian outbreak of 1905

The virus of infantile paralysis acts upon the nervous system and especially upon the nerve cells of the spinal cord which control muscular movements The muscles themselves are not directly affected Since the virus injures the nerve cells and adjacent tissues with varying degrees of intensity, the effects on the muscles range from very slight to severe paralysis Even when the paralysis is severe, restoration of motion takes place in part or even wholly as the injurious consequences of the disease subside

Although the name—infantile paralysis—carries the implication of actual loss of motion by muscles, yet many cases of the disease never show paralysis at all Indeed, there are reasons for believing that the cases of the non-paralytic disease exceed greatly in number those in which actual paralysis occurs

Infantile paralysis is mainly but not wholly a disease of childhood Adults are affected but infrequently Now that we have learned that young children have rarely and older children and adults have often become immunized through unperceived or subclinical effects of exposure, we can better understand the peculiarities of age and place susceptibilities

GENETICS AND EVOLUTION[1]

By Professor MAURICE CAULLERY

UNIVERSITY OF PARIS

IT seems to me that one of the functions of a congress such as this one, where for the moment many zoologists of all nations and all interests are gathered, is to examine the situation presented by the great problems which change from time to time but which are never completely solved Such a study is particularly useful in certain phases when our diverse doctrines tend to clash or are not altogether incompatible Now this is actually the case at the present time with the problem of evolution Since the peculiar character of my work as a teacher at the University of Paris, devoted as it is to the study of evolution, has led me to constant reflection on the subject, I thought you might permit me to submit some aspects of more timely problems to the consideration of the congress at this reunion of zoologists.

Indeed the nature of the researches most in favor at the present time compel us to face a situation that exists in other congresses (especially the Genetical) where the problem of evolution is brought up indirectly, and where the mass of zoological data is screened behind results of special methods, a procedure which often leads to paradoxical conclusions Certain eminent geneticists are even beginning to think that the conclusions of their scientific studies, being based on precise and methodical experimentation, should force us to abandon the idea of evolution whenever their work contradicts it Others, without going so far, conclude that evolution should only be accepted to the extent that it is in strict conformity with genetical laws, that all conclusions to which zoology and paleontology lead should be deliberately excluded I do not flatter myself that I have any solution of the difficulty to offer, nor even a new point of view I should like merely to sail close to the wind, as sailors say, and to confine myself to considerations of a general nature, and perhaps to provoke useful reflection and discussion I have already had occasion to set forth my views and three years ago, I heard a botanist, Professor R von Wettstein, express analogous views at the Berlin Genetical Congress Even this year I noticed that some of these ideas had been presented at a meeting of the combined German Genetical and Paleontological Societies There is, moreover, a general uneasiness in regard to these ideas, which, it seems to me, may well have an echo here

---

[1] Address at the opening of the eleventh International Congress of Zoology, Padora, September 4, 1930 Translated from the author's manuscript by J C. Greenway, Jr

The beliefs held when the generation to which I belong did its apprenticeship in science were very different from those of to-day Then the problem of evolution seemed much nearer solution than it does now The theory itself was no longer seriously contested, nor did we hesitate to reconstruct the phylogeny both of larger and smaller groups by means of genealogical trees and a general application of the fundamental biogenetic law Haeckel was the prophet of those days which have now begun to be remote To-day we are far more cautious in this matter

In regard to the mechanism of evolution, too, we believed ourselves to be much nearer the truth It seemed that we had only to choose between the theories of Lamarck and Darwin, or to complete the doctrine of one of these great forerunners with that of the other Was not Darwin in his later years the first to recognize that he should have made greater concessions to Lamarck's ideas? Environment appeared without question to be the most powerful agent for the transformation of organisms and it moulded them adaptively to the environment under the control of the struggle for existence and natural selection. When one rereads the works of that time, written by the most orthodox of Darwinists (for example, the beautiful books of A R. Wallace, inspired by his zoological explorations in the Malay Archipelago), one feels on almost every page that these views are in a sense automatic.

August Weismann initiated a change of capital importance about 1885 when he tore down the supposed proofs of the heredity of acquired characters, proofs that were scarcely thought necessary, so obvious did they seem And we must surely recognize that, in spite of all efforts since that time, the proof of such heredity, even in limited cases, is still to be furnished The opposition which Weismann remarked between soma and germ-plasm, and from which he deduced the theoretical impossibility of the inheritance of acquired characters, is undoubtedly too radical And yet we can not deny that his contention has been at least one of the pivots of biological thought in the last decade, and that his theory of the germ-plasm was a remarkable anticipation of future modes of thought It affected the ideas underlying cytological work and the most important experimentation that has been done since the beginning of the twentieth century under the combined influence of the concept of mutation, introduced by Hugo de Vries, and the laws of Mendel which had been rescued from oblivion at the same time On this double foundation the science of genetics has reared itself, and you are well aware of the important place that it holds in contemporaneous biology

Let us recognize without any mental reservation or restriction whatsoever the value of the results of genetical investigations and the considerable progress that they represent Into an indefinitely complex field like that of heredity, where empiricism reigned, gratuitous statements were made and speculative views advanced, the science of genetics has introduced methodical observation and strict experimentation The result has been that certain general and simple laws have been detected for phenomena of heredity which once seemed essentially arbitrary Thanks to these laws, we are now enabled to prognosticate with certainty, and this is the most unquestionable criterion of true scientific knowledge. It therefore behooves us neither to cast doubt upon nor deprecate the value of the results of genetics but only to endeavor to determine the real scope of their application

We may say that a first series of these results, which constitutes, as it were, a gateway to genetics proper, has its source in analytical experimentation on variations and furnishes us with a more precise notion of species Nowadays we distinguish much more clearly two categories of variations, on the one hand those that are purely individual and not hereditary, *i e.*, of the phenotypic order, as we say We have ascertained that in general they are due to the action of environmental factors, that is, of factors external to the organism, and, viewed statistically, obey certain simple laws and are explainable by polygons of variation or Quetelet's curves. On the other hand, there are variations due to differences in hereditary constitution, or, as we say, genotypic. The species is not a genotypic unity but a collectivity of genotypic constitutions, the units differ from one another in details and remain distinct in cases where self-fertilization is the rule (these constitute the pure lines of Johannsen), or, in the most frequent cases where cross fertilization has taken place, they may be mixed and combine among themselves indefinitely. The Linnean species may be separated into secondary units, which are theoretically as numerous as the distinct genotypes, *i.e.*, to an indefinite number. Practically speaking, this amounts to recognizing the legitimacy of the conception of an elementary species, which had been so remarkably clarified in a series of plants by the botanist, Alexis Jordan. For this reason the name "Jordanon" has been suggested for the fundamental genotypic unity.

Obviously genotypic properties can best be studied in the pure lines. This problem in Johannsen's work has led the author to a double conclusion, first, that the genotype is altogether independent of outside influences, which merely produce the individual variations or phenotypes, and second, that selection has only the power to isolate, without changing, the genotypes which are pre-existing but confused in a population. In fact, these conclusions of Johannsen's are the result of observations on very limited material (the pedigreed culture of a limited number of strains of Princess beans during a few generations). It is certainly a very bold induction to extend—*mutatis mutandis*—to all animals and plants and even to cases of cross fertilization. Nevertheless, it may be admitted that it is likely enough that they have at least a certain general value in the present state of organisms. On the whole these conclusions amount to a deductive announcement of the fixity of the genotype, that is to say, he concludes that species are fixed in relation to their environment, and this is a downright repudiation of Lamarckism.

Genetics proper has been the experimental analysis of the genotype by the method of crosses. Its principal results are now classic. Henceforth we may consider as solidly established the fact that the constituent properties of the genotype depend primarily on the nucleus and more especially on the chromosomes. Every one knows how far Thomas Morgan and his collaborators have been able to push this analysis in *Drosophila melanogaster*. As a result of these magnificent researches, which look upon genes and their localization as tangible realities, a veritable genetical mentality has been created. These, however, have merely imaginary existence. Be this as it may of genes and their positions, the mass and precision of concordant and experimental results deduced from this conception indicate that there is at least some correlation between it and reality. Everything happens as if genes were exactly as the geneticists say they are. They permit of experimentation and prognostication, and this justifies their use, but it must not be forgotten that they are only symbols. They have permitted us to clarify the idea of mutation and its treatment. If we put aside the very special case of *Oenothera*, which has made its fortune, mutation constitutes a phenomenon, examples of which have been cited over a period of years. Darwin knew them under the name of "sport" and "single variations." We have been able to straighten out long series of facts from investigations of the nineteenth and even the eighteenth century, and some have been found of a much earlier date. A great number of our cultivated plants and races of domestic animals are mutations perpetuated from olden times by human beings. However, it is genetics alone that has yielded a good understanding of their properties, and by means of the Mendelian theory of crosses, has permitted us to tie up their breeding with the alteration of a gene or a limited but definite number of genes. They are, on the whole, genotypical variations.

The special value of mutations lies rather in their hereditary character than in their discontinuity. For if these mutations, which correspond to large variations attracted attention first, we now know that mutations can manifest themselves as small variations with the appearance of continuity. The method of crossing enables us to bring about their transmission and to group them *ad libitum* under the limitation of their correlations. You know how successfully this has been accomplished in *Drosophila*.

Knowing that mutations are hereditary variations, which represent distinct typical forms of a species, we are led naturally to look upon them as the processes by which new and lasting forms have come into being. Admitting, on the other hand, that variations due to the environment are individual and not transmissible, and that phenotypical modifications can not be repeated by the genotype, mutations appear to be the principal if not the only form of evolutional change. The Darwinian theory can be applied to them in the sense that in all produced mutations natural selection has eliminated the unfavorable to the advantage of the favorable.

Since, owing to the proof of the existence of mutations themselves and of their hereditary peculiarities, genetical laws are positive facts of experience, the doctrine of evolution appears to rest on a solid basis of experiment.

First of all, it appears from the various results of genetics that the plasticity which Lamarck attributed to species is real only from the individual and phenotypical point of view, but, when envisaged in a specession of generations, the species is on the contrary quite stable. It is characterized by a totality of genotypical and fixed attributes, and occurs in varied environments under more or less diverse phenotypical forms. The species is therefore a reality and not an individual, nor is it always susceptible to change in a continuous or arbitrary fashion under the influence of external factors which constitute the environment. The objections made by Lamarck's contemporaries to the identity of the hypogea of Egypt together with those of our time are of undoubted value. And we may even go further, since paleontology itself proves the stability of various forms during often extremely long geological periods, and sometimes even from the remotest ages. Thus there are certain ants from the amber deposits of the Baltic, that is to say from the Oligocene, which are scarcely different from the ants of the present, and therefore the typical ant was already completely and definitely developed at that time. In general, therefore, species are stable, at least in the present epoch.

Do mutations, as far as is known, actually exhibit a process leading to the formation of new species, and do they account for evolution? Such is the opinion of geneticists, and it has been developed in a masterly manner by Monsieur Emile Guyenot, professor at the University of Geneva, in a work which recommends itself by its lucidity of exposition, accuracy of documentation, and faithfully adheres to the actual facts.[3] However, I do not believe that mutations and genetical laws are sufficient to account for evolution, as it is accounted for by morphological and paleontological data.

First of all, as we know them, and as genetics has explained their growth, it is doubtful whether mutations really constitute new developments in the descent of a species. Moreover, they appear to represent rarely occurring combinations of normal elements of the genotype, that is to say, they are forms virtually contained and preexisting within the species considered as stable. Evolution, on the contrary, ought to be conceived as brought about by the production of new types which were not preceded by similar forms. The mammalian type is not really contained in the fish nor the reptilian type.

Now mutations are attributed to modifications of already existing genes and it is significant that we have almost always been forced to consider these modifications as degradations or losses. This follows from the fact that from the Mendelian point of view a large majority of known mutations behave like recessive forms. Dominant mutations are much rarer. Recessive forms are not apt to evolve since they usually will be transmitted in a heterozygote condition in which they are masked. Crosses intentionally combined by the experimenter are essential if they are to be perpetuated and revealed in the homozygote condition. Moreover, mutations which are continually occurring in a state of nature are hardly ever met with there, or fail to maintain themselves. Practically speaking, we do not find the very numerous mutations of *Drosophila* which Morgan has isolated and propagated in his cultures. Then, too, almost all the mutations obtained are malformed or weak individuals which would quickly be eliminated by selection in a state of nature. Furthermore, the better one knows the genetics of a species like *Drosophila* the more numerous appear the non-viable and lethal mutations. The number of those that are able to maintain their place in the sun without the aid of man is very small. Is there not a profound reason for this state of affairs? Is there a reason for the numerical predominance of recessive over dominant mutations and for the fact that the majority of them have defective constitutions? Is it necessary to see an essential and elementary process of evolution in a phenomenon which appears to our eyes, in the majority of cases at least, to be subpathological?

The following is an objection of another sort. Are mutations, as at present understood, really evolutionary processes, that is to say, are they capable of giving rise to distinct species and of eventually splitting up into diverse groups?

Without doubt all the mutations exhibited by a species correspond well enough morphologically to the diversity among natural species or even among allied species in the same genus. But if we examine them from the point of view of physiology we find, notwithstanding the often very considerable variation of form and structure that they assume, that they nevertheless remain strictly within the frame of the stock species. This is shown by the general and unlimited fecundity which they exhibit in crosses with the parent species. Many of Morgan's *Drosophila* mutations (like the one with vestigial wings, for example) differ in a much more striking manner from the normal form than do the various species of wild *Drosophila* (*D. virilis*, *D. confusa*, etc.). Nevertheless the close sexual attraction to the normal form holds good and fertility is wholly preserved, whereas, on the contrary, crossing does not occur or give results among wild species which are hardly distinguishable from one another. The criterion of fecundity, in spite of the numerous and important exceptions which might be cited to the contrary, is perhaps still the surest criterion of specific difference, and the sterility of the crosses or the absence of sexual affinity is the fact which permits natural species to exist side by side Mutations do not, therefore, result in the formation of distinct physiological populations as would true species Therefore, why look upon them as the essential processes by which evolution, that is, the production of independent species, has been brought about? Genetics, nevertheless, readily explains why this should be so From the genotypical point of view a mutation differs from the normal stock only by a single or a very limited number of genes, all the others remain identical On the contrary, two closely allied natural species differ by the ensemble of their genes, that is, by their whole genome, which almost always reveals itself materially by the number of the arrangement of the chromosomes And this gives us sufficient insight into the infertility or the limited fertility of the cross When, exceptionally, crossing is possible and normally fertile between distinct species, as Erw Baur has observed among species of *Antirrhinum,* then the second generation, F_2, exhibits enormous polymorphism From one single hybrid seed (F_1) the issue of one of these crosses, Baur was able to secure in the (F_2) generation more than 150 different types Now this is interpreted by supposing that the two crossed species differed by a great many genes, and hence a considerable multiplicity of distinct combinations among the gametes And certain geneticists, like Lotsy, starting from this conclusion, are seeking the source of the production of new types and of all evolution in hybridization

---

[3] E. Guyenot, "La Variation et l'Evolution," 2 vols., Paris, 1930 (Encyclopedia Scientifique, G. Doni, editeur).

However, be this as it may, mutations do not arise from a process corresponding to a fundamental genotypic change of an order of magnitude like that which separates one natural species from another Are we justified then in seeking among the phenomena of mutations for the sole and fundamental laws of evolution? Or rather are not these laws of a much more complex character, the mutations entering into them as a partial element, but without thereby implying the exclusion which genetics is leading us to formulate?

It is significant that when we have started with mutations and genetics and tried to formulate an explanation of evolution, we have only arrived at disconcerting paradoxes This was the case of the late lamented William Bateson, one of the most eminent geneticists, and who is still considered to be one of the masters of contemporary biology Almost all the mutations known to him being recessive, he explained them by the loss of a gene, on the genetical theory which he called "presence-absence," and which to-day I admit has been abandoned We should have to admit, therefore, that new forms resulted from successive losses in their genotypes, that is to say, that evolutionally superior forms of the animal and vegetable kingdom are due to a progressive simplification of the initial complexity of the most primitive and inferior forms Thus man would seem to be a simplified *ameba* No doubt there is a touch of humor in the idea, although it revealed an embarrassment in constructing a theory of evolution on the basis of mutations

One other grave difficulty with the conception that evolution is fundamentally the result of mutations, to the exclusion of all Lamarckian mechanism, is the explanation of adaptation, that is, the frequently astonishing structural conformity between organisms and their conditions of existence

Adaptation, which is one of the most difficult questions in biology, has been much discussed of course in the past and even recently Formerly naturalists saw it everywhere and marvelled at the wisdom of Providence which had endowed every living being with all the organs best suited to its rôle in nature Such was even Cuvier's point of view Lamarck, on the contrary, announced that adaptations were *a posteriori* results, an effect on the organisms of environmental conditions which modeled them To-day, it is well established that adaptation is not a universal characteristic of organisms There are many and important details in every organism that have no adaptive significance whatsoever, but which even seem to be maladapted Obviously the organism gets along as well as it can with the organs which it possesses and its manner of living is regulated by its organs Certain biologists are even beginning radically to reject this morphological order and to consider all evidence brought to bear in support of it as pure illusion due to coincidence I am unable to subscribe to this point of view An organism such as a cetacean or a bird is manifestly the result of transformations of an original type, which are strictly correlated with an aquatic or an aerial mode of life. The reality of adaptation being admitted, its realization is as difficult as it is important. The Lamarckian solution pure and simple, according to which the need suffices to create the organ, can not be adopted Furthermore, the most clearly adaptive characteristics of the individual are apparent in ontogeny before any functioning of the organs. The mutation theory permits us to regard adaptation only as the fortuitous result of variations non-adaptive in themselves but which are preserved by selection in the event that they are found to be favorable. This was Darwin's concept also But can we admit that a series of chances has developed such highly coordinated wholes as the body of a cetacean or that of a bird, or can mere chance have set up certain organs which are veritable machines, or tools such as the human intelligence constructs. To explain these facts it seems to me that it is impossible to reject the direct action of the environment on organisms or the influence of the phenotype on the genotype, that is to say, a mechanism of the kind suggested by Lamarck Every theory of evolution should be able to explain even circumscribed adaptation, but I doubt whether it can be done by genetics.

There are then undeniable difficulties in explaining evolution in general by means of genetical data and the phenomenon of mutation Therefore, what attitude shall we adopt?

There are geneticists who remain strictly in the territory of the established facts and experimental results and who deliberately sacrifice everything that stands in their way. If the genetical mutationist can give no account of evolution, and evolution is a mere hypothesis, then there is no alternative but to sacrifice this hypothesis Such is the conclusion at which certain eminent geneticists such as Mr Heribert Nilsson are arriving

Evidently there would be no disposition to accept such conclusions on the part of the majority of zoologists and botanists For them evolution, as a fact, obviously results from all data of comparative anatomy, embryology and paleontology Naturally I shall not enumerate the arguments, which are classic, that support this statement. Nevertheless, we are clearly unable to avoid taking account of the positive results of experimentation But what seems to me to be of vital importance is their true significance

However extensive experiments of this sort may be—the most ample are Morgan's on *Drosophila*—they are always extremely limited in comparison with the totality of natural facts and we are always able to ask ourselves whether the best conceived experimentation really embraces all the natural conditions, not only of actual present conditions but also those of the past. Alfred Giard, one of the biologists of the end of the last century who had the widest knowledge of zoology and botany and the most penetrating insight into evolution, was in the habit of poking fun (and with good reason) at certain botanists, who, he said, could not recognize the crucial value of an experiment unless they had repeated it in a flower pot Nature, he added, shows us irrefutable and clearly significant experiments which she has made and which we can never dream of reproducing, but which we can not fail to interpret. Thus, by parasitism, she has converted a cirriped into a rhizocephalan, such as *sacculina*. Now all the essential phenomena of evolution are of this kind; they are experiments which require such a long time for their performance as to be impossible for us But even if we reject this subterfuge, nature herself probably no longer performs such experiments at the present time and has realized them only at certain epochs without our being able to discover the reason She does not keep repeating them continually The period during which terrestrial mammals related to the carnivores passed over to a marine life and became pinnipedia and cetaceans is confined to a limited portion of the earth's history We may make every effort to breed dogs or even such purely aquatic animals as otters during many successive generations without being able to produce seals, porpoises or anything approaching them Moreover, it is not in a continuous or repeated manner that the species of crustaceans, cirripeds, copepods or isopods adopted a parasitic way of life and underwent the transformations which produced the rhizocephalia, the various parasitic copepoda and the epicaridae Paleontology is a witness to the fact that all these evolutional changes are brought about in each group only during a limited period, and, in most cases, an extremely remote one. It is even conceivable that they have been evolved with relative rapidity, after which everything indicates that they had attained a perfectly stable equilibrium, as genetics has clearly demonstrated What conditions have influenced these transformations, the reality of which is evident, we do not know We know only that evolutionary changes are not brought about in all groups at the same time The reptile type, which had become so highly diversified at the beginning of the Mesozoic period, remained perfectly fixed and stable at the beginning of the tertiary, in the many forms which are still surviving to-day, at the same time that the diversification and evolution of mammals was going on in large and rapid strides. Without ignoring the fact that to establish an evolution the past must be considered and the present must always, *a priori*, give an illusion of stability, we may seriously ask ourselves whether evolution has not been completely accomplished and whether the organisms whose stability and fixity are established by genetics, have not lost the mysterious ability of transformation, at least to a considerable extent, in the present stage of the earth's history As the paleontological past teaches, the evolution of groups is limited, as Dollo has so ably contended. Evolution is not a process that is carried on indefinitely or continuously or at a uniform speed. Every group has had its stage of differentiation, after which it is congealed, as it were, into already acquired forms. We ought to ask ourselves if the characteristics we recognize in existing organisms are identical with those of the geological epochs of which paleontology gives us such an adequate picture It is possible that at that time the phenotype had an effect on the genotype and that, in accordance with the general sense of Lamarck's theory, if not in accordance with its formulation, an environment contributed to the modification of organisms which transformed themselves, moreover, to a great extent independently of the environment, in conformity with the correlations resulting from their intimate structure It seems that at the present time we do not know whether stabilized nature and genetics will inform us of the modalities of this stability Are these conclusions of genetics valid for the periods and the conditions during which each group became diversified? Or rather, as seems more probable to me, do the evolutional transformations depend on some other causes which still elude us? I am not concealing from myself the fact that it is very improper to imagine that the causes known at present are insufficient to explain the past and I ask pardon But I still prefer to adopt such a supposition rather than to deny evolution or to confine myself to a statement of the contradictions between the results of our inadequate experimentation and the facts attested to by the past

I ask your indulgence for having preempted your attention so long, only to end with such doubtful conclusions, but, as I said in the beginning, my intention was above all to emphasize the difficulties of the problem and to provoke reflections, suggestions and even contradictions among the experts present

SCIENTIFIC EVENTS

THE INTERNATIONAL CONFERENCE ON BITUMINOUS COAL

The Third International Conference on Bituminous Coal will be held at the Carnegie Institute of Technology from November 16 to 21, it is learned from Dr Thomas S Baker, organizer of the meeting and president of the Carnegie Institute of Technology

Prospects for the third congress are excellent. "Because of the deep concern that is felt all over the world as a result of the great depression in the coal industry, it is felt that it is a particularly appropriate time to hold our conference," Dr Baker said "There has been some pressure to have the meeting postponed for another year These suggestions have come principally from some of the European scientists, but it is thought that because of the condition of the industry it is very important that we go on with our plans"

One of the objections of the foreign scientists to coming to this country this year, apart from the difficulty of securing necessary funds, is the fact that so many industrial plants are shut down that they will be unable to study American methods of business In spite of these conditions, there will be a larger number of European delegates than were present at the previous conferences

"The conferences in the past have been devoted to the scientific aspects of coal utilization," Dr Baker continued "As this meeting is sponsored by a technological institution, the emphasis has been placed on new methods of utilizing and treating coal which are continually being developed When the first meeting was organized in 1926, it was undertaken with the hope and expectation that it would be of service to the coal industry and the subsequent meetings have been planned with this in mind

"Although in comparison with the previous meetings, the scientific program next November will be of equal, perhaps greater, importance, it is impossible to discuss coal at the present time without reference to the economic aspects of the industry Therefore the various processes that will be presented will deal very definitely with economics and less with theoretical questions There will be a certain number of papers that will be solely economic in character"

The congress will unite scientific men from all over the world, who will bring to Pittsburgh the latest developments in soft coal utilization Some of the foreign delegates will speak also on the coal industry as a business in their respective countries, and it is felt that suggestions will be made by them that will be helpful to American coal men

The conference will be attended by representatives from Austria, Belgium, Canada, Czechoslovakia, England, France, Germany, Italy, The Netherlands, Poland, Roumania, Spain, Sweden, Switzerland, South Africa and U S S R

PAINTINGS OF PREHISTORIC LIFE AT THE FIELD MUSEUM OF NATURAL HISTORY

The series of twenty-eight large mural paintings depicting life on the earth in successive prehistoric ages from about one and one half billion years ago down to the beginning of the modern era, which has been in the course of preparation for the Field Museum of Natural History during the past several years, has just been completed with the installation of the last three paintings, it has been recently announced by the director of the museum.

The paintings are a gift to the museum from Ernest R Graham, an architect of Chicago, who provided a fund of $125,000 for them and certain other material illustrating historical geology The hall in which they are exhibited has been named in Mr. Graham's honor by the museum's board of trustees

Charles R Knight, of New York, known as a foremost painter in the very specialized field of paleontological restorations, is responsible for all the paintings. Museum authorities state that in them Mr Knight has performed some of his most notable work

The paintings are in two sizes, the largest being 25 by 9 feet, and the others 11 by 9 feet, being thus designed to form a continuous series about the walls of Ernest R Graham Hall Twenty-five previously completed were placed on exhibition and announced at various times during the past five years as they came from the artist's studio

Of the three final paintings, one depicts the primitive hoofed animals known as Uintatheres and the four-toed horse called Orohippus which lived approximately 55,000,000 years ago, another shows flying reptiles, primitive birds and small dinosaurs of 175,000,000 years ago, and the third illustrates primitive African reptiles of the Permian age, some 215,000,000 years back

Other subjects illustrated in the complete series include the following The cooling earth before life began, the beginnings of the lowest orders of life, a sea beach of Ordovician time, a coral reef which existed in Silurian time on the present site of Chicago, North American reptiles of Permian time, a forest of Devonian time, large flying and marine reptiles of Jurassic time, swimming reptiles, armored dinosaurs, plant-eating dinosaurs, horned and carnivorous dinosaurs, egg-laying dinosaurs, duck-billed and crested dinosaurs, titanotheres, primitive whales, early camels and suillines, early elephants and rhinoceroses, giant kangaroos and wombats, New Zealand moas, South American ground sloths and armadillos, saber-tooth tigers and vultures, mastodons, cave bears, mammoths and woolly rhinoceroses, and the great Irish deer

The restorations on canvas are intended to show how prehistoric creatures are believed to have appeared when living, as indicated by careful scientific studies of fossils In the work the artist has had the advice of Dr. Oliver C Farrington, curator of geology at the museum, and also of many other scientists in other institutions. The series as a whole represents one of the most extensive and elaborate attempts ever made to reconstruct the prehistoric world, and is expected to be of great educational value.

COUNTY HEALTH DEPARTMENTS

"Approximately 600 county health departments should be in operation throughout the United States before the close of 1931," Acting Assistant Surgeon Fred T. Foard, of the Public Health Service, states in a recent issue of "Public Health Reports" as reported in the *United States Daily*.

The movement for full-time county health departments throughout the country has made great progress during the nineteen years since the first full-time unit was established on July 1, 1911, in the state of Washington

About 24 per cent of the rural population is now being served by a health service that is reasonably effective, but in which there is still room for improvement There are about 3,000 counties in the United States in which full-time county or district health service is applicable The development of this tremendous field in the future can take place only as fast as personnel can be trained to take charge of the individual units

With so great a demand for trained personnel during the next ten or twenty years, and with the many added responsibilities which are being incorporated into the public health program in increasing numbers each year, the public health official must be progressive if he would successfully meet the situation The time when the political appointee can expect to be tolerated in the public health field without progressing with the movement is about past The people the country over are very rapidly coming to know what the prevention of disease and the promotion of the public health mean in a literal sense

They realize its importance both from the standpoint of the prevention of unnecessary suffering and death and from the standpoint of dollars and cents saved Public sentiment, therefore, is demanding higher standards and more efficient health-protective service than could be given a decade ago, when public health appointments were made primarily to fulfil political obligations and, perhaps, secondarily, to the lowest bidder for the position

Since the full-time county health department movement started a little less than twenty years ago, the national death rate from all causes has dropped from a little more than 14 per 1,000 population to 11, the tuberculosis (respiratory) death rate has dropped from 138 per 100,000 population to 68, the infant-mortality rate has been reduced from 129 per 1,000 children born to 68, the typhoid fever rate has been reduced 80 per cent, and the diphtheria rate has been reduced about 65 per cent in the same period of time

With such an enviable record to look back upon the public health field has greater progress to look forward to and to work for in the future Although many of the public health executives are still handicapped by lack of funds to carry on rapidly expanding programs, it is nevertheless true that the health officer who possesses the qualifications of leadership, statesmanship and organization ability can frequently overcome handicaps which would otherwise completely retard his progress. The Public Health Service should carry on with ever-broadening viewpoints of the rapidly growing and fascinating field of public health administration. The old adage "There is more in the man than there is in the land" is just as true of the field of public health as it is in farming, or in any other line of endeavor.

THE BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH

ACCORDING to the London *Times*, a meeting of the trustees of the Beit Memorial Fellowships for Medical Research was held on July 14, for the election of fellows and the presentation of the annual report of the honorary secretary, Professor T. R. Elliott.

In the report of last year a review was given of the work of the Beit Memorial Trust in the first twenty years since its foundation. The close of that year marked the period that had been chosen for the review with a sharper line, by the death on December 8 of the founder of the trust, Sir Otto Beit. The founder's generous resolve to perpetuate the memory of his brother, Mr. Alfred Beit, by augmenting more than fourfold the gift which the latter had wished to make for the progress of medical studies in the University of London did not conclude with the endowment by £210,000 of the trust. As chairman of the trustees, Sir Otto devoted to the very end of his life the closest thought to every step that might advance the aims of the foundation, and he showed the keenest interest and pleasure in marking those successes in the advance of medicine by research which have been achieved by the most distinguished of the Beit Fellows. His sense of service to the trust that he had created gave an example that will not be forgotten.

The resignation of Sir Charles Martin and Sir James Kingston Fowler was announced and the appointment of Sir John Rose Bradford, who in 1909 was chiefly responsible for the advice that led to the trust being guided to the creation of fellowships rather than to other purposes, and who served for twelve years as an original member of the advisory board. Sir Alfred Beit has consented to serve with them in the place of his father, Sir Otto Beit. Dr. J. C. G. Ledingham, F.R.S., now director of the Lister Institute, who will serve in the place of Sir Charles Martin, and Dr. P. P. Laidlaw, F.R.S., known for his work on vaccination for dog distemper, have also been elected members of the advisory board.

The number of fellows at present working on the foundation, excluding those reported for election, is twenty-three. The report states that the list of places recognized for research has long ago been widened beyond the limitation suggested by the first idea that work would be done chiefly in the laboratories and schools attached to the University of London, and each year more and more fellows are being permitted for special purposes to work for a year abroad. The fellows elected choose their own problems for research, and no attempt is made by the board to select a subject or appoint a group to investigate it.

It is pointed out in the report that the aim of the fellowships is to start a man on the career of research, and the fruits of his work can hardly be expected to mature during that relatively brief tenure. It is to the after-careers that the trustees look for proof that the advisory board has guided them well in the selection of fellows. Last year's report gave a comprehensive review of the careers of the fellows since the foundation of the trust. During the present year Dr. C. H. Lambie, who held a fellowship from 1923 to 1926, has been appointed to a new whole-time chair of medicine at the University of Sydney, New South Wales. Dr. D. Keilin, F.R.S., has been chosen for the directorship of the Institute for Parasitology at Cambridge, to which he was first appointed to work as junior Beit fellow in 1920, and where he remained throughout the fourth year and senior fellowships for a total period of seven years' research. He now controls the laboratory at which his work in England began.

Besides six junior fellowships valued at £400 a year, one senior fellowship valued at £700 a year was awarded to Dr. F. R. Winton, to continue his work in the pharmacological laboratory of University College, London, on the tonus of plain muscle, on the blood pressure in the glomerulus of the kidney, and on the effect of drugs on kidney secretion. A fourth year fellowship valued at £500 a year was given to B. H. C. Matthews, to continue his work in the physiological laboratory, University of Cambridge, on the analysis of sensory nerve impulses by electrical records obtained with the delicate oscillograph which he has invented.

SCIENTIFIC NOTES AND NEWS

DR. HARVEY CUSHING, head of the department of neurological surgery at Harvard Medical School, has received an honorary degree from the University of Berne at the opening of the International Congress on Neurology which met recently in Berne, Switzerland. Dr. Cushing read a paper on his experiences in two thousand brain operations.

DR. A. S. HITCHCOCK, custodian of grasses at the U. S. National Herbarium, has been elected a corresponding member of the German Botanical Society.

DR. JOSEPH B. WOLFFE, associate professor of cardiology in the school of medicine and the hospital of Temple University, was honored on September 1 by members of the staff of his heart clinic, who entertained him at a testimonial dinner in the Hotel Sylvania. Dr Wolffe, who has passed many years in research into the causes and treatment of heart disease, returned recently from a tour of this country and South America, having visited leading heart clinics.

The Frank M. Meyer Medal for distinguished services in the introduction of new plants to America has been awarded to Allison V Armour, of New York The presentation was made on August 24 by Dr Gilbert Grosvenor, president of the National Geographic Society, on board Mr Armour's yacht *Utowana*, which was anchored off Beinn Brheagh, Nova Scotia, the summer residence of Dr and Mrs Grosvenor The medal was awarded for the series of eight expeditions which Mr Armour has made on his yacht to bring from foreign countries useful and ornamental plants to enrich the farms and gardens of the United States

The Royal Geographical Society of Antwerp has awarded its Gold Medal to Mr Bertram Thomas, in recognition of his explorations in Arabia

The Planck Medal has been awarded by the Physical Society of Berlin to Dr Arnold Sommerfeld, of the University of Munich

The Academy of Sciences at Vienna has awarded the Fritz Pregl Prize for microchemistry to Dr Friedrich Feigl, and the Wegscheider Prize to Dr Philipp Gross Both recipients are docents in the University of Vienna

Dr Bernard Sachs, of New York, has been elected president of the International Congress on Neurology

At the annual meeting of the Mt Desert Island Biological Laboratory, the following officers were elected *President*, Clarence C Little, *vice-president*, Duncan Starr Johnson, *treasurer*, David O Rodick, *secretary* and director of the Weir Mitchell Station, W H Cole, director of the Dorr Station, R L. Taylor, and honorary director, Herbert V Neal The following members were added to the board of trustees W H Cole, R W. Hegner, E. K. Marshall, Jr, S O Mast and H W Smith. New members of the corporation are: A. L. Graffin, P. L. Johnson and D. O Rodick

Glenn L. Martin, aircraft manufacturer, of Baltimore, has been selected to open the sixty-seventh session of the Royal Aeronautical Society on September 16, as the Wilbur Wright Memorial lecturer, it was announced on August 25 Mr. Martin will address the society on "The Development of Aircraft Manufacturing" in the aeronautical section of the South Kensington Museum, with the permission of the director, Colonel Sir Henry Lyons, and a discussion will follow the address. At the meeting of the Royal Aeronautical Society Mr. Martin will present the Daniel Guggenheim Medal to Dr Frederick W. Lanchester, British aviation engineer and aerodynamic expert, in recognition of his service towards the advancement of aeronautics in developing his theory of flight based on the vortex theory

Dr. Frederick G Cottrell, formerly director of the U. S Fixed Nitrogen Research Laboratory, recently delivered a lecture at the Scripps Institution of Oceanography on "Research Work of the Fixed Nitrogen Research Laboratory of the U S Department of Agriculture"

Dr. Leslie T Webster, of the Rockefeller Institute for Medical Research, New York, delivered a series of three lectures on epidemiology before the Pacific Northwest Medical Association at its recent Seattle meeting

Dr Allen F Stone has been appointed head of the department of surgery at the University of Maryland and has also become surgeon-in chief of the James Lawrence Kernan Hospital for the Crippled.

Dr. Joseph S Illick, formerly state forester of Pennsylvania, has been appointed head of the department of forest management of the New York State College of Forestry at Syracuse University

Appointments to the faculty of the Duke University School of Medicine and Duke Hospital include Dr Bayard Carter, professor of obstetrics and gynecology, and Dr Edwin C Hamblen, associate professor of obstetrics and gynecology

Dr Virginius Elholm Brown has been appointed professor of biology and chairman of the department at Bethel College

Dr. Helen Miller, of Johns Hopkins University, has had her National Research fellowship in zoology renewed and will spend the coming year in the department of zoology at Yale University Dr Daniel Raffel, a National Research fellow in the department of genetics of the Johns Hopkins University, has been reappointed and will continue his work also at Yale University

Dr. Alvin R Lamb, of the Wisconsin Agricultural Experiment Station, has accepted a position as biochemist in the U. S Public Health Service He will join the staff of the Leprosy Investigation Station at Honolulu on September 1 to work on biochemical aspects of the pathogenesis of leprosy

Mr. Dudley Moulton has resigned as horticultural commissioner for the City of Los Angeles to accept the appointment as state director of agriculture in California.

Dr. Catherine C Steele will become lecturer in agricultural chemistry and physics at the Horticultural College, Swanley, Kent, England.

Dr. Laignel-Lavastine, senior physician to the Hôpital de la Pitié, and secretary of the International Society of the History of Medicine, has been nominated professor of the history of medicine in the Paris faculty in succession to Professor Menetrier

Lord Ilchester and Professor J Stanley Gardiner have been elected trustees of the British Museum They succeed Lord Ullswater and Lord Chalmers, respectively

Dr William R Amberson, professor of physiology at the University of Pennsylvania, sailed for Germany last week He will work in the laboratory of Professor Rudolf Hoeber in Kiel during the coming semester

Dr. W R Jillson, director and state geologist of the Kentucky Geological Survey, was appointed on August 28, by Governor Flem D Sampson, delegate to represent the Commonwealth of Kentucky at the International Geographical Congress which meets in Paris from September 16 to 24 Dr Jillson, accompanied by Mrs Jillson, sailed early in September He will also represent the Kentucky Geological Survey, Syracuse University, the University of Washington and the Kentucky Academy of Science Dr Jillson will read a paper before the congress on "The Geography of Kentucky"

Mr Raymond C Shannon, who worked on Diptera in the U S National Museum some years ago and has since been continuing with mosquito work in Brazil under the International Health Board, returned to Washington on August 3 and will be in the United States for about six months Mr Shannon will spend most of his time in the study of mosquitoes

Dr Roscoe W Teahan, medical director of Jeanes Hospital for the treatment of cancer in Philadelphia, has returned from a six weeks' tour for the study of cancer in medical centers of Europe

Under the will of the late Payne Whitney, who left an estate valued at $200,000,000, the following institutions received legacies The New York Hospital, $21,691,593, New York Public Library, $7,230,531, Cornell University, $3,286,605, Nassau Hospital, $657,321, Groton School, $1,314,642, and to trustees for charitable and educational purposes, $30,236,766

The Barker Foundation of Chicago has made a grant for research by Robert H Gault, of Northwestern University, during a period of five years beginning on September 1 The work relates to the sense of touch and the possibility of extending its usefulness as a medium for learning to interpret and to use spoken language A grant for the same research through a two-year period, beginning on September 1, has been made by the Illinois State Department of Public Welfare.

Under the will of Mrs Mary F W. Dickinson, $5,000 has been bequeathed to the New York Association for the Blind and $2,000 to the Chicago Nursery and Half Orphan Asylum.

The American Hospital Association will hold its convention from September 28 to October 2 Dr Winford H Smith, director of the Johns Hopkins Hospital, will read a paper at the meetings

The meeting of the American Public Health Association opened on August 28 in Montreal, under the presidency of Dr Hugh S Cumming, surgeon-general of the U S Public Health Service

The German Society of Heredity will hold its meeting in Munich, from September 13 to 17 There will be a reception on September 13 On September 14, a review will be delivered by Dr Paula Hertwig on "Artificial Production of Mutations and its Theoretical and Practical Results," followed by reading of papers A review by Dr Schwemmle-Erlangen on "The Relation between Cytology and Genetics in Oenothera Studies" will be given on September 15, followed by papers On September 16, there will be three reviews as follows von Verschuer on "Biological Basis of Human Multiple Births", Siemens on "General Results of Human Twin Investigation", Luxenburger on "Relation of Human Twin Investigation to Medicine" The reviews will be followed by papers

The nineteenth annual meeting of the Indian Science Congress, according to *Nature,* will be held in Bangalore from January 2 to 8, 1932, under the presidency of Rai Bahadur Lala Shiv Ram Kashyap The following persons have been elected sectional presidents Agriculture, Mr G N Rangaswamy Ayyangar, mathematics and physics, Professor Ganesh Prasad, chemistry, Professor P R Ray, zoology, Professor D R Bhattacharyya, botany, Dr Haraprasad Chaudhuri, geology, Mr Percy Evans, medical and veterinary research, Lieutenant-Colonel A D. Stewart, anthropology, Mr. J P Mills; psychology, Professor N S N Sastry

The first Congress of Medical Geography will be held at Geneva in October The subject for discussion will be hepatic cirrhosis

Thirty-seven countries were represented at the Berne Hygiene Exposition and International Congress on Neurology, which met at the University of Berne, from August 31 to September 5 Professor W Sachs, of New York, presided over the 1,200 delegates from America and Europe. The president of the Swiss confederation was honorary chairman

The second International Congress of Tropical Medicine will be held in Amsterdam, Holland, from

September 12 to 17, 1932, under the presidency of Professor G. Grijns. The main subjects to be discussed at the general session of the congress are (1) Avitaminoses with special reference to beri-beri, (2) yellow fever and 2b leptospiroses, (3) helminths with special reference to hookworms, and (4) malaria with special reference to blackwater fever. Special speakers have been invited for each of the above subjects. In addition to the general meeting, section meetings will be held at which there will be an opportunity to discuss other subjects. Persons desiring to participate in the congress should notify the general secretary, Professor E. P. Snijders, Institute of Tropical Hygiene, Amsterdam, Holland, not later than December 31, 1931. The subscription fee is one pound sterling (12 Dutch guilders), payable at the Nederlandsche Bank, Amsterdam.

According to *Industrial and Engineering Chemistry*, the van't Hoff Fund, founded to endow investigators in the field of pure and applied chemistry, has available for 1932 approximately 1200 Dutch guilders. Applications must be sent by registered mail to Het Bestuur der Koninklijke Akademie van Wetenschappen, bestemd voor de Commissie van het "van't Hoff-Fonds," Trippenhuis, Kloveniersburgwal, Amsterdam, Holland, and must be received before November 1, 1931. Applicants should give a detailed account of the proposed use of the grant and of the reasons upon which the claim is based. Copies of papers resulting from the work must be sent to the committee, but may be published in any journal, with a note to the effect that the work was supported by a grant from the van't Hoff Fund.

Before attending the meeting of the American Public Health Association in Montreal, Canada, an official delegation of physicians, representing the Association of Medical Officers of Health of Great Britain, is making a study of federal, state and municipal health organization and administration in the United States.

The trustees of the University of the Philippines have closed the college of dentistry "because disputes had destroyed the usefulness and efficiency of the college."

Ritter Hall, the new $120,000 laboratory at the Scripps Institution of Oceanography, opened about September 1. The new building will make available an additional 14,000 square feet of laboratory space, which will augment the laboratory space in the library building and in the George H. Scripps laboratory building. The new laboratory occupies a ground space of 46 by 100 feet and is three stories in height. The first floor contains laboratories equipped with tanks for salt-water fish, a laboratory for photographic purposes, a twelve-unit refrigeration department, in which salt brine is maintained at an even temperature, a transformer vault, boiler rooms, a carpenter shop and workrooms.

A series of illustrated lectures will be delivered in the lecture hall of the Museum Building of the New York Botanical Garden at 3:30 as follows: September 5, "Microscopic Projection of Plant Sections," Professor W. J. Bonisteel, professor of botany and pharmacognosy at Fordham University; September 12, "Flowers in Late Summer Gardens," Mr. Kenneth R. Boynton, head gardener; September 19, "The Gardens of the World," Colonel E. A. Havers; September 26, "Color Photography in the Garden," Mrs. Jerome W. Coombs, of Scarsdale; October 3, "Dahlias," Dr. Marshall A. Howe, assistant director; October 10, "Plant Distribution in Malaya," Dr. Elmer D. Merrill, director-in-chief; October 17, "Autumn Coloration," Dr. A. B. Stout, director of laboratories; October 24, "Botanical Activities in the United States," Dr. John Hendley Barnhart, bibliographer; October 31, "The Ancestral History of Some Living Plants," Dr. Arthur Hollick, paleobotanist; November 7, "Autumn in the Garden," Mrs. Wheeler H. Peckham, honorary curator, iris and narcissus collections; November 14, "Some Edible and Poisonous Mushrooms from Maine," Professor H. Beaman Douglass; November 21, "A Botanist's Rambles through the West Indies," Mr. Robert Hagelstein, honorary curator; November 28, "A Winter in Bermuda," Dr. Fred J. Seaver, curator.

DISCUSSION

SUBMERGED PEAT BEDS AMONG THE APOSTLE ISLANDS

In Science for February 13, 1931, Dr. L. R. Wilson, of the University of Wisconsin, discusses evidences which seem to show a recent lower lake level in the western part of the Lake Superior basin. The evidences consist of peat and overlying sand that was dredged from the bottom of the lake at two localities among the Apostle Islands. It is stated that the peat was brought up from a depth of 54 feet and was covered by about 14 feet of lake sand. It is stated, further, that upon analysis the peat was found to be very fresh and that the sand shows characteristics which indicate that it was deposited since the retreat of the last ice-sheet. Dr. Wilson ventures the opinion that the occurrence of this peat in the situation described "is not in accordance with our present ideas concerning the post-glacial history of the region." I would like to point out that, instead of being out of accord with our present ideas, the submerged peat beds among the Apostle Islands appear to constitute by far the best evidence yet found in support of our present interpretation of the lake history

Dr Wilson gives a reference to Dr Frank Leverett's recent report on the "Moraines and Shore Lines of the Lake Superior Region" (U S Geological Survey, Professional Paper 154-A, 1929) In this paper, Dr Leverett makes the statement that after the outlet of the Nipissing Great Lakes had become established at North Bay, Ontario, " the differential uplift raised the outlet at North Bay so high that the lake waters were brought up to the St Clair outlet at Port Huron By this rise any shore work done by the Nipissing Great Lakes south of the isobase that runs through the North Bay outlet would have been submerged and to a large degree obliterated. The original Nipissing beach is to be seen, if anywhere, only in the extreme northeastern part of the Lake Superior basin The visible Nipissing beach is therefore, in the main, the product of the shore work after this rise, at a time when both the North Bay and the St Clair outlets were in use" (page 70)

Thus, the *original* Nipissing beach marks the first stage of the Nipissing Great Lakes, and the *visible* beach (commonly called simply "the Nipissing beach") marks the second stage The first stage had one outlet, and that was at North Bay, Ontario, the second had two outlets, for the gradual elevation of the land in the north backed the water up toward the south and finally caused an overflow into the St Clair River at Port Huron, Michigan Continued uplift finally diverted the whole discharge from North Bay to Port Huron, ending the Nipissing Great Lakes and inaugurating the present or post-Nipissing lakes.

The Nipissing beach at North Bay has an altitude of 698 feet above sea-level Studies along the north shore of Lake Superior by A C Lawson in 1892 and by the writer in 1895 furnished data for drawing the isobase of the North Bay outlet It runs west-northwest (about N 68° W) from North Bay and passes close to Mazokama on the north side of Nipigon Bay This isobase cuts off about 50 miles of the present shore of Lake Superior in its extreme northeastern part, and it is only in this stretch north of the isobase that the first or original Nipissing beach can now be seen Everywhere south of the isobase, the original Nipissing beach is submerged, and the visible shore line in that area is in reality the beach of the later, two-outlet stage Thus, southward from the isobase the plane of the original Nipissing beach passes more and more deeply under the plane of the later or two-outlet stage. This relation of the two lake stages and of the beaches which represent them was well established in 1895, but the amount of submergence at any given place south of the isobase has remained unknown for lack of clearly defined evidence. The submerged peat bed of the Apostle Islands appears to supply the first reliable evidence bearing on the depth of submergence of the original Nipissing beach.[1]

Knowing the characteristics of peat and the normal conditions of its growth, we seem justified in believing, tentatively, that the peat described by Dr Wilson was formed at or very near to the level of the Nipissing Great Lakes during their first or one-outlet stage. Peat is formed mainly in clear, quiet waters free from notable disturbance and from all sedimentation, whether by wave action and shore currents or by streams It is, of course, conceivable that the peat in question was formed in a bog, in a drainless basin on a post-glacial land-surface, but it seems much more probable that it was formed in a lagoon close to the lake shore of that time, protected from wave-and-current sedimentation by a bar between it and the lake, and at the same time receiving no stream-borne sediment from the adjacent land From these considerations it seems probable that the submerged peat west of Sand Island lay very close to the lake level of that time, probably within a foot of it or less

Dr Leverett found that the plane of the two-outlet stage intersects the present lake surface about on a line running west-northwest from Washburn, Wisconsin, and meeting the north shore near Knife River, 20 miles northeast of Duluth. From this line the imaginary plane of the two-outlet stage rises toward the north-northeast about six inches per mile to the isobase of North Bay Dr. Wilson states that the peat locality is about one and one half miles west of Sand Island, which would place it about 15 miles northeast of the isobase of Washburn The plane of the two-outlet stage passes, therefore, over the peat locality about seven or eight feet above the present lake surface, or something like 62 or 63 feet above the peat, thus affording a tentative measure of the interval between the plane of the original Nipissing beach and the plane of the two-outlet beach at that particular place.

If a line parallel to the isobase of North Bay be drawn through the peat locality and produced toward the southeast it passes over the northern part of Lake Michigan and the southern part of Lake Huron. These lakes are both 20 feet lower than Lake Superior, so that, if we assume, tentatively, that the submerged plane of the original Nipissing beach passes uniformly through all three of the lake basins, this beach should be found at a depth of about 34 feet in the basins of Lakes Michigan and Huron on the isobase of Dr. Wilson's peat locality in the Apostle Islands.

---

[1] The history of the Nipissing Great Lakes and the relations of their beaches and outlets are discussed in U. S. Geological Survey, Monograph 53, Chapt. XXII, especially pages 456–7, 1915.

In the Lake Huron basin the isobase of the peat locality produced from Lake Superior passes roughly 40 miles north of the zero or hinge-line of the northern uplift. At and south of this line there appears to have been little or no uplifting of the land since the beginning of the Nipissing Great Lakes, so that in this interval, or more probably in the southern part of it, the uplift died out, and the plane of the original Nipissing beach meets the subaqueous slope or, if the depth of the basin permits, becomes horizontal at the hinge line and continues southward in that attitude. The depth of the submerged horizontal stretch is not now known, but seems likely to be near 40 or 45 feet.

In the Professional Paper referred to above (pages 71–2), Dr. Leverett refers to G. R. Stuntz's finding of submerged tree stumps in place at the mouth of St. Louis River west of Duluth. In the area southwest of the Washburn isobase, the plane of the beach of the two-outlet stage passes below present lake level. The drowning is probably 12 to 15 feet at the river's mouth. Since the slow uplift turned the narrow strait at Sault Ste. Marie into a river, the level of Lake Superior has been controlled by that barrier. Its isobase, parallel with that of the North Bay outlet, strikes the north shore near Grand Portage Bay, Minnesota. In the whole area south of this line the shores of the lake are now undergoing progressive drowning. If the submerged peat west of Sand Island lies close to the level of the original Nipissing beach this fact affords a more accurate basis for the study of many interesting problems relating to the history of the Nipissing Great Lakes. The occurrence of the submerged peat in the Apostle Islands is decidedly in accord with our present knowledge of the post-glacial history of the region.

FRANK BURSLEY TAYLOR

FORT WAYNE, INDIANA

NORTH AMERICAN PHYLLOPODS

IN SCIENCE, February 27, 1931, Mr. C. H. Behre, Jr., has presented some interesting questions concerning the zoogeography, ecology, and natural history of *Branchinecta*. His paper has prompted the following notes and discussion.

The occurrence of *Branchinecta coloradensis* at high altitudes is not necessarily an index of relationship. If the species in question had resulted from isolation since the glacial epoch, it should be related morphologically to the species *B. paludosa* of the arctic. The genus *Branchinecta* has representative members in Brazil, Patagonia, Russia, Hungary, Australia, Asia Minor, Mongolia, Tibet, United States and the circumpolar regions of the north and south. In all, about thirteen species are now known, five of which occur in North America. The relationships of the various species have not been adequately considered. However, there is no more reason to believe *B. coloradensis* morphologically related to *B. paludosa* of the arctic than *B. granulosa* from Patagonia, *B. packardi* from Colorado, or *B. ferox* of Russia, Hungary and Asia Minor.

In a recent paper[1] I have shown the distribution of the two continental species of *Streptocephalus*. Since that time I have collected *S. sealii* in small pools in the jungle between Jalapa and Vera Cruz in the state of Vera Cruz, Mexico. *S. sealii* is now known northward as far as Medicine Hat, Alberta and southward to the *tierra caliente* of Vera Cruz, Mexico. The ranges of the two continental species overlap on the central plateau, but the remarkable thing ecologically is, that, as yet, the two species have not been taken together in the same pool.

Thamnocephalus platyurus, *Streptocephalus texanus*, and *Apus aequalis*, were taken near Cerritos, San Luis Potosi, Mexico, in a roadside pond on June 2, 1930. *Leptestheria compleximanus* was obtained on May 14, 1930, in pools of the Lago de Texcoco in the Federal District, Mexico. A species of *Apus* found in the same region is, according to the peons, used as food during the occurrence of the phyllopod in the winter months.

Concerning the question raised by Mr. Behre of the method of establishment of a phyllopod fauna, it should be noted that probably all phyllopod eggs can withstand desiccation. Many possibilities exist for transportation of eggs. Wading birds, turtles, mammals including man, are possible transporters. We do not know, as yet, whether or not the eggs of phyllopods are viable after passing through the intestinal tract of vertebrate animals. Many species of entomostraca have been reared from mud obtained by travelers in foreign lands. G. O. Sars has written several papers on entomostraca obtained in this manner.[2] This suggests the means by which ponds may become stocked with fairy shrimp and other entomostraca.

My observations with *Eubranchipus vernalis* lead me to believe that death normally occurs shortly after breeding. The males die first, and this is the probable explanation of the statement so often found in the literature on various species of Phyllopoda: the male of this species is unknown. A resting period of unknown length is necessary before the eggs can hatch. Thereafter the appearance of the fairy shrimps is governed ecologically by factors such as temperature, rainfall, and the chemical constituents of the environment In some instances drying of the eggs appears necessary

---

[1] E. P. Creaser, Occ. Pap. Mus. Zool. Univ. Mich., No. 217, 1930.

[2] G. O. Sars, *Skr. Vidensk. Christiania*, 95, 8, 1–56. *Arch. Naturv.*, 18, No. 2, 1–17. *Ibid.*, No. 3, 1–81.

It may be of interest to note that in the collections of the University of Michigan Museum of Zoology there are some specimens of *Branchinecta coloradensis* taken from a hollow in a boulder These were obtained on Sept 14, 1916, at Estes Park, Colorado, at an elevation of 8,000 feet.

It is quite apparent that the phyllopods are zoogeographically unruly Ecologically they are profoundly interesting, and they certainly merit, as Mr C H Behre, Jr, says, a detailed study of their life history

EDWIN P CREASER

UNIVERSITY OF MICHIGAN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TECHNIQUE FOR FIXING AND REMOVING CHICK BLASTODISCS AND EMBRYOS FROM THE EGG SHELL

FOR some time I have been looking for a simple, rapid and effective method for removing blastodiscs and embryos from the egg shell which might be used both by the technician in making up quantities of whole mounts or serial sections, and one which can be readily acquired by students in the classroom who have had very little or no training in handling such delicate objects. The method outlined by Dr M F Guyer in his "Animal Micrology" (p 127) is very good, but in order to use it the worker must have had considerable experience Because of this I have found it impracticable to use in the classroom when both time and material are limited

The technique outlined by Dr C E McClung in his "Handbook of Microscopic Technique" (p 213) is the best I have so far been able to find, but in using the formal-nitric fixative recommended (three parts ten per cent formalin to one part ten per cent nitric acid) I experienced difficulty in removing the vitelline membrane, and also in washing the blastodisc free from yolk. The length of time required by the McClung method for the fixative to act sufficiently to permit the removal of the blastodiscs or embryo was from fifteen to twenty minutes During the past year and a half I have prepared several hundred whole mounts and serial sections of blastodiscs and embryos. By modifying the formal-nitric fixative suggested by Dr McClung from three parts of 10 per cent. formalin and one part 10 per cent. nitric acid to four parts of 10 per cent formalin and one part of 20 per cent nitric acid, I have found that I can remove as many as sixty blastodiscs or embryos up to ninety-six hours' incubation within an hour and a half with the aid of an assistant, whereas the original method as outlined by Dr McClung required from four to five hours to prepare the same number. Comparative studies of tissue fixed by the two different concentrations of the fixative did not reveal any differences in their effect upon cell structure.

The following is a summary of the procedure I followed:

(1) Incubate the egg to the desired stage

(2) Remove the egg from the incubator to a finger-bowl filled with normal salt solution (Seven to nine grams NaCl per liter of distilled water)

(3) Using a pair of small forceps and curved scissors, remove the upper part of the egg shell to expose the blastodisc or embryo

(4) Flood the blastodisc with several drops of the formal-nitric fixative Remove the coagulated albumen and apply more of the fixative Repeat this operation until the blastodisc is free from albumen When all of the albumen is removed flood the blastodisc or embryo with the fixative and permit it to act for from one half to two minutes

(5) Cut around blastodisc with curved scissors.

(6) By inserting a section lifter into the yolk under the blastodisc, lift the latter and transfer it to a Syracuse watch-glass filled with normal saline. Agitate the salt solution until the blastodisc is washed free from the yolk, and then transfer it to a watch-glass of fresh salt solution

(7) Remove the vitelline membrane by grasping its free edge with forceps and move the membrane gently back and forth until it becomes free

(8) Transfer the blastodisc, washed free from yolk and vitelline membrane, to a dish of Worchester's fluid[1] (Nine parts ten per cent formalin saturated with mercuric chloride to eleven parts glacial acetic acid.) It is desirable to place about a quarter of an inch of the fixative in a rather large flat-bottomed dish in order that the embryonic tissue being fixed will lay flat

(9) Place the tissue in seventy per cent. alcohol containing iodine colored to that of port wine to remove the corrosive sublimate. (Three to ten hours.)

(10) Preserve in fresh seventy per cent. alcohol until ready for use.

MARK M. KEITH

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF MINNESOTA

---

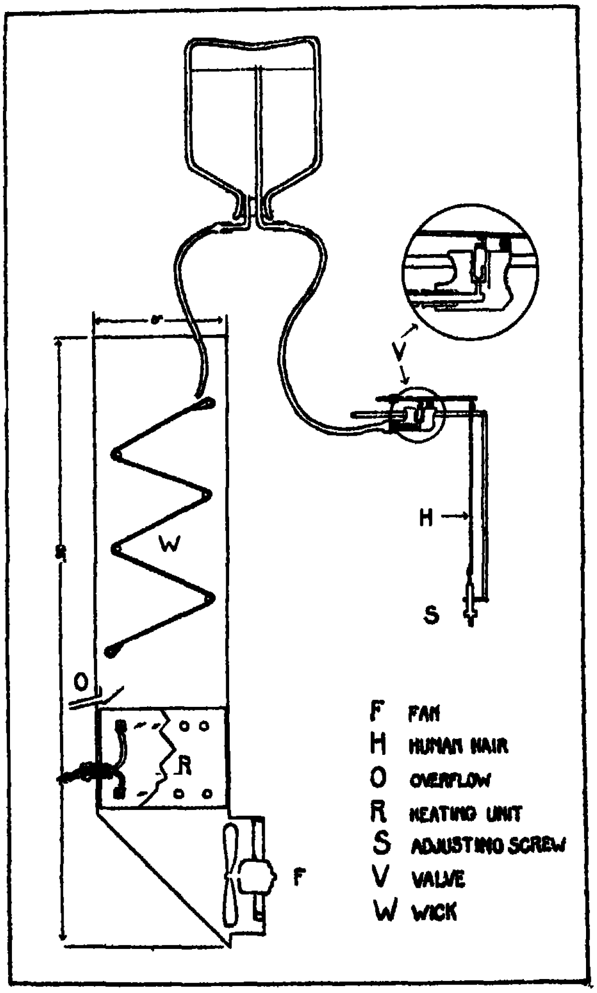
[1] Fixatives other than Worchester's may be used if desired, but for total mount work Worchester's is preferable since it has a tendency to leave the tissue tough rather than brittle as do many fixatives.

A HEATING-HUMIDIFYING DEVICE FOR INCUBATORS

THE apparatus described herein is believed to fill a long-felt want in biological laboratories for a cheap and efficient heating and humidifying unit for incubators The original unit cost approximately $12 00, including the six-inch fan It has been in constant use for several months in an incubator of forty cubic feet capacity used for insect rearing work and has given complete satisfaction

The chief features of the apparatus may be summed up as follows (1) Heating, humidifying and circulation of the air in the incubator are all taken care of by one compact unit (2) Any reasonable temperature above that of the surrounding atmosphere may be automatically maintained as accurately as the thermoregulator used will permit (3) Any relative humidity above that of the surrounding atmosphere up to 95 per cent may be maintained automatically, and independent of variations outside (4) The fan in the unit maintains sufficient circulation in the incubator to insure uniform conditions throughout (5) The maintenance and regulation of the humidity is independent of the heating device and may be used to maintain a constant humidity while the temperature is allowed to vary

The unit, as illustrated in the diagram, consists of a metal box about three feet long and eight inches square, and open at both ends The bottom opening is at the side and is made round to accommodate the blades of a six-inch electric fan, F This fan operates constantly at a reduced speed The heating unit, R, consists of a coil of resistance wire wound to three hundred watts and surrounded on the sides by an asbestos casing. This is connected to the electric service through an electric thermoregulator, which may be placed in any suitable place in the incubator Above this and supported on brass rods is a zig-zag porous cotton wick, W Water drips on the top of this wick from a tube connected to an inverted bottle which rests on the top of the incubator or in any convenient place which is slightly above the unit. The water thus fed to the wick is carried off to the incubator by evaporation in the air current produced by the fan Water can only leave the bottle as air is admitted. The admittance of air is governed by the valve, V. This is made from old carbureter parts and is opened and closed by the contraction and expansion of strands of human hair, H, the same as used to activate the hand on a standard hygrograph. Adjustment is made by the screw, S, and the percentage humidity determined by testing with a hygrograph or wet and dry bulb thermometers O is a small overflow to take care of any surplus water which may come down, caused by the valve opening wide when the door of the incubator is kept open unduly long and the air in the incubator has become dry.



A more complete description of the apparatus with photographs will be published later along with hygrothermograph charts indicating the capabilities of the instrument. To date the tests it has been possible to give the apparatus have been somewhat limited, due to the necessity of keeping it in constant use for a particular type of work. It has, however, demonstrated its ability to maintain an even humidity of over 90 per cent. when the room humidity was as low as 40 per cent., both with and without constant heat.

GEORGE WISHART
A. B BAIRD
PARASITE LABORATORY, ENTOMOLOGICAL
BRANCH, DOMINION DEPARTMENT OF
AGRICULTURE, BELLEVILLE,
ONTARIO, CANADA

SPECIAL ARTICLES

COMBINATION OF BACTERIAL POLYSACCHARIDES AND COLLODION PARTICLES AS ANTIGENS

Preliminary Report

Loeb and his associates[1] have shown that the adsorption of proteins by collodion particles makes possible the use of certain physico-chemical methods that can not be applied to protein in solution. Jones[2] demonstrated that collodion particles coated with various proteins are agglutinated by their specific antisera. Freund[3] studied the adsorption of diphtheria and tetanus toxin and antitoxins on the surface of the collodion particles. Further work done by Dr. Freund, of the Henry Phipps Institute, and ourselves with the adsorption of bacterial polysaccharides on the surface of collodion particles and the agglutination of them by immune sera proved that its homologous polysaccharides were also adsorbed by the collodion particles as were the toxin and antitoxin. Polysaccharides, as such, when injected have not proven to result in antibody formation. Many have assumed that fairly complex nitrogenous substance had to be a part of the polysaccharide combination to make these antigenic. It occurred to us, however, that this might not be necessary and that combinations might be prepared which may owe their antigenic properties to a physical basis or arrangement rather than to an organic chemical combination. (I am aware of Langmuir's idea of the chemical nature of adsorption in colloids.)

The collodion particles are mixed with anthrax polysaccharide in a dilution of 1–100, (this polysaccharide contains 0.03 per cent. N) cooled for five minutes and washed four times with salt solution, centrifuging each time for 10 minutes. This heavy suspension of particles was standardized (by turbidity) to an approximate concentration of 5,000,000,000 per cc. Agglutination tests were made in test-tubes, diluting the serum up to 1–64 and adding an equal amount of the collodion particle suspension. Incubated for 2 hours at 37° C. The reading was checked with a hanging-drop under the microscope. Proper controls were made with non-homologous polysaccharide adsorbed to the collodion particles, as well as using normal horse serum and other heterologous sera for the agglutination test. We obtained specific agglutination in a dilution of 1–32 and sometimes in a dilution of 1–64, with the collodion particles adsorbed with anthrax polysaccharide and its specific antiserum.

For our immunization experiments, several combinations of adsorbed substances to the collodion particles were prepared.

(1) Collodion particles adsorbed with 1 per cent. anthrax polysaccharide.

(2) Collodion particles adsorbed with normal horse serum, washed 4 times, then adsorbed with anthrax polysaccharide.

(3) Collodion particles adsorbed with anti-anthrax globulin, washed, and then adsorbed with anthrax polysaccharide.

(4) The washed precipitate of anti-anthrax globulin and anthrax polysaccharide, without collodion particles.

In the first case, we wanted to find out the results of the polysaccharide alone adsorbed to the particles. In the second case, normal horse serum adsorbed first, washed 4 times, and then the polysaccharide, hoping to find out the effect of a foreign protein and a polysaccharide combination, and lastly adsorbing specific antiserum first, then washing, and followed by the specific polysaccharide with the object of increasing the amount adsorbed according to the findings of Freund in working with diphtheria toxin, where he found that collodion particles, treated first with antitoxin and then with toxin, were slightly but definitely more toxic than particles treated with toxin alone. As controls, rabbits were immunized with the suspended washed specific antibody precipitate obtained from immune serum and its specific carbohydrate. It was not thought necessary to try rabbits immunized with polysaccharide solution alone, as other investigators as well as ourselves have failed.

The rabbits were immunized by injecting intravenously 0.5 cc, 1.0 cc and 1.0 cc on consecutive days and rested for 5 days. A second and third series were made increasing the dose to 3 cc. Seven days later they were trial-bled and agglutination and precipitin tests were made. The results are given in Table I.

The variation in titer of the different series is thought to be due to variation in the response of the individual animal, although the animals injected with the antibody precipitate seemed to give higher value. For the present we are not giving special significance to this finding. The third series also seems to be better than the first.

To ascertain if the foreign protein in the second, third and control series had given anti-horse antibodies, specific horse precipitin was tested for and positive reaction found in all the rabbits injected, except those which received collodion particles and polysaccharide alone. The presence of specific anti-horse precipitins demonstrate that the material ad-

---

[1] J. Loeb, "Proteins and the Theory of Colloidal Behavior," 1922.

[2] F. S. Jones, *Jour. Exper. Med.*, XLVI, 303 (1927); *Ibid.*, XLVIII, 183 (1928).

[3] J. Freund, *Proceed. Soc. for Exper. Biol. & Med.*, 1930, XXVIII, 65.

TABLE I

Agglutination Tests with Serum of Rabbits Immunized with Collodion Particles Adsorbed with Anthrax Polysaccharide and other Combinations

	Injected with	C particles and anthrax SSS			C particles and antianthrax Gl and anthrax SSS			C particles and normal horse serum and anthrax SSS			Anthrax Gl anthrax SSS ppte		
	Rabbit No	6704	6705	6706	6707	6708	6709	6713	6714	6715	6710	6711	6712
Final serum dilution	1/4	4	4	3	4	4	3	4	4	4	4	4	4
	1/8	4	3	2	4	4	3	2	3	4	4	4	4
	1/16	4	2	2	4	4	2	1	3	2	4	2	4
	1/32	4	1	1	2	4	1	0	2	1	1	0	3
	1/64	2	0	0	2	2	0	0	0	0	0	0	1

Incubated over night in water bath at 37° C

sorbed on the particles is available for stimulating antibody response

These results may offer an explanation of why polysaccharides and other substances (of the class of haptenes) are not antigenic when injected alone in solution in the body The collodion particles provide an enormously increased surface to the polysaccharide (haptene) and make them available in a different physical form on injection Other factors no doubt come in

Further work is being done on many of the problems here suggested, especially in finding other colloids which may be employed for the same purpose, as well as the immunization of different animals with various bacterial polysaccharides Work is in progress with the protection of mice against pneumococci with the specific carbohydrate to collodion particles At the same time we have adsorbed several polysaccharides in the same collodion particles with the hope of forming a multiple antigen The result of all this work will be published later

José Zozaya

Mulford Biological Laboratories,
Sharp & Dohme,
Glenolden, Pa

LIGNIN AS A NUTRIENT FOR THE CULTIVATED MUSHROOM, AGARICUS CAMPESTRIS

The cultivated mushroom, *Agaricus campestris*, in common with other fungi, must obtain all the nutrients necessary for its growth and reproduction from the organic matter of the substrata upon which it grows, this organic matter also serving as a source of energy Horse manure is commonly used as the source of organic matter for the cultivation of the mushroom, although recently attempts have been made to replace this manure by composts of so-called "artificial manure" prepared from straw and other plant residues, from peat, etc. The chief point to be considered in the use of manure or composts of plant residues is that, in order to obtain a fair growth of the mushroom, the manure and residues must first be thoroughly composted, this process lasts, under favorable conditions, from 4 to 12 weeks The microorganisms active in the composts bring about a number of chemical changes in the various organic complexes, these can be briefly summarized as a reduction of the water-soluble substances, of the hemicelluloses and cellulose, and an increase in the lignin, ash and protein content

The problem is to determine which of these chemical constituents in the compost form the nutrients for the mushroom, whether all the organic complexes are attacked alike, or whether some are acted upon to the exclusion of others This problem is both of theoretical interest and has considerable practical application

It is known, from studies of the activities of wood-destroying fungi, that some organisms attack the cellulose of the wood, but not the lignin, while a few are capable of attacking the lignin as well as the cellulose. With the exception of these wood-destroying fungi, very few organisms are known so far capable of decomposing lignin and using this material as a source of energy and as a nutrient material Although lignin has been shown to be generally much more resistant to decomposition by microorganisms than celluloses and hemicelluloses, as shown by its relative persistence in composts, peat bogs and soil, it still undergoes some decomposition, especially under aerobic conditions, otherwise the whole surface of the earth would soon be covered with lignin, since all plant residues, with the possible exception of the algae, contain from 5 to 30 per cent lignin

In order to illustrate the changes that take place in the composting of stable manure, a typical analysis of a compost of horse manure is given Table I. If one assumes that the concentration of the mineral

TABLE I

CHANGES IN THE CHEMICAL COMPOSITION OF HORSE MANURE PRODUCED BY MICROORGANISMS IN THE PROCESS OF COMPOSTING

Chemical constituent	Fresh manure	Compost 27 days old	Compost 108 days old
Total nitrogen	1.58	2.05	2.62
Ether soluble portion	1.85	1.28	0.70
Cold water soluble portion	4.45	6.64	5.11
Hot water soluble portion	2.95	7.43	3.85
Hemicelluloses	18.84	15.26	11.74
Cellulose	27.41	20.41	12.00
Lignin ...	17.69	19.98	22.30
Water-insoluble protein	8.25	11.50	13.56
Ash	12.51	17.80	25.50

constituents of the manure increase in inverse proportion to the reduction of the organic constituents, the doubling of the ash content of the compost within 108 days indicates a reduction of the total organic matter to one half of the original material. Of the four most important groups of chemical complexes of the manure, namely, the hemicelluloses, cellulose, lignin and protein, the first two diminished in relative concentration, especially the cellulose, while the last two increased in proportion. It is these two complexes, namely the lignin and the protein, which are used predominantly by the mushroom fungus for their growth and activities, as shown in Table II.

TABLE II

DECOMPOSITION OF THE VARIOUS CHEMICAL CONSTITUENTS OF FRESH AND COMPOSTED MANURE BY AGARICUS CAMPESTRIS

Chemical constituent	Fresh manure: Proximate composition per cent. of dry material		Total amount in culture per cent of original	Composted manure: Proximate composition per cent of residual dry material		Total amount in culture per cent of original
	Control	Culture		Control	Culture	
Total material		..	94.0		..	90.6
Total nitrogen	1.44	1.65	107.2	1.5	1.6	96.0
NH_4-N per cent of total N ..			..	2.7	5.2	192.6
Ether-soluble	2.3	1.4	57.2	0.7	0.6	72.9
Hot water soluble organic matter ..	5.6	11.9	199.3	3.6	10.5	264.7
Water soluble nitrogen per cent of total nitrogen	25.3	40.0	..	15.2	39.4	......
Hemicelluloses	18.6	14.4	72.8	7.1	6.6	83.2
Cellulose ..	20.7	20.8	94.5	14.8	16.7	101.9
Lignin	20.0	15.7	73.8	20.8	14.8	64.5

It is important to note that, as a result of the growth of *Agaricus campestris* upon fresh and composted manure (these experiments were carried out by inoculating sterilized manure with pure cultures of the organism), there was very little reduction in the total weight of the compost, the actual loss was only 6 to 9.4 per cent of the original material. This reduction is only apparent, since the mushroom fungus synthesizes an extensive quantity of mycelium, which compensates for a large part of the organic matter of the compost which has been lost through decomposition. This is illustrated by the marked increase of the water-soluble organic matter and the nitrogen as a result of the growth of the fungus, the increase in these complexes is due entirely to the fact that over 40 per cent of the mycelium of the fungus, on a dry basis, is water soluble.

Of the more important organic complexes, the cellulose was either not attacked at all by the mushroom, as in the case of the composted manure, or reduced only to a limited extent. The hemicelluloses were markedly reduced, especially in the fresh manure. The most striking phenomenon is observed in the reduction of the lignin, which forms the most abundant group of organic complexes in the composted manure and of which more than one third was decomposed by the mushroom in 47 days. The reduction of the lignin in the composted manure accounts, in these experiments, for nearly 80 per cent of the total reduction in the weight of the original material. There is no doubt that the protein of the compost has also undergone considerable change, as shown by the increase in ammonia and in water-soluble nitrogen. The fact that the mushroom contains about 6.5 per cent total nitrogen, a large part of which is soluble in water, is responsible for this.

One may, therefore, feel justified in concluding that *Agaricus campestris* feeds largely upon the lignin and protein of the manure and to a less extent upon the hemicelluloses, cellulose and other complexes. Further, that the need for the composting of manure, in order to develop a favorable medium for the growth of mushrooms, consists in bringing about an enrichment in the lignin and protein content and possibly in a change in their chemical nature.

A detailed discussion of these experiments and their bearing upon the problem of mushroom nutrition will be published later.

SELMAN A. WAKSMAN
W. NISSEN

NEW JERSEY AGRICULTURAL
EXPERIMENT STATION

SCIENCE

Vol. 74 Friday, September 18, 1931 No. 1916

Plant Sciences in the Sheffield Scientific School: Professor Russell H. Chittenden 273
The Need of Cooperation in Biochemical Research: Professor Treat B. Johnson 276
Industrial Science—A Gilt Edge Security: Maurice Holland 279
Obituary:
Memorials; Recent Deaths 282
Scientific Events:
The American Celebration of the Anniversary of the Inventions of Michael Faraday and Joseph Henry; The Annual Meeting of the Optical Society of America; The Museum of Anthropology of the University of California; The One Hundredth Anniversary of the Leeds School of Medicine 282
Scientific Notes and News 285
Discussion:
The Control of Predatory Mammals: H. E. Anthony. *Fitting the Curve of the Diminishing Increment to Feed Consumption Live Weight Growth Curves*: Walter A. Hendricks. *The Effect of the Application of a Field of Attraction to a Gas*: Professor R. D. Kleeman 288
Scientific Apparatus and Laboratory Methods:
The Iowa Eye Movement Camera: Herbert H. Jasper and Robert Y. Walker 291
Special Articles:
The Great Glacial Cycle: Dr. William T. M. Forbes. *Eggs of Fresh Water Fishes Suitable for Physiological Research*: Dr. Floyd J. Brinley and Dr. Charles W. Creaser 294
Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

PLANT SCIENCES IN THE SHEFFIELD SCIENTIFIC SCHOOL[1]

By Professor RUSSELL H. CHITTENDEN
YALE UNIVERSITY

As a noted English scientist, Sir Walter Fletcher, has said recently, "In the field of research the whole body of knowledge has been advancing so fast that the individual workers, at their various points on its growing borders, are in danger of becoming so far separated one from another in the very course of their advance as to lose the fertility that comes from the easy exchange of ideas and methods." Hence, the value of such gatherings as this, by which workers in specialized fields can compare methods and results, gain perhaps added enthusiasm and encouragement, and go forth with renewed vigor in the prosecution of their own particular studies.

As a physiological chemist I like to think in broad terms of physiology as a study of the functions of living organisms, animal and vegetable; a study of the functions of living matter irrespective of its origin. Differentiation of these functions, as we all know, is determined largely by the character of the methods that have to be followed in their study. Thus, we emphasize chemical physiology and physical physiology mainly because the functions concerned are explainable by chemical laws or by physical laws, their study involving on the one hand the intricate methods of the chemist, while on the other the methods of the physicist are called for. Again, we stress the terms animal and plant physiology, recognizing thereby the innate differences in function characteristic of the two forms of life, understanding full well that in the higher forms individual functions can be studied successfully only by different technical methods applicable to each type. If we talk about physiological chemistry or biochemistry we are giving expression to the fact that owing to deepening knowledge there is a large accumulation of chemical data of the greatest physiological importance and significance which chemistry has been, and still is, making available. Such data have value largely as they throw light on, and help explain, physiological processes.

---

[1] An address delivered at the Conference for Investigators Interested in the Chemistry and Physiology of Plants, at New Haven, Connecticut, June 5, 1931.

While to-day knowledge of plant physiology has progressed so far as to cover a wide field, with trained workers constantly contributing new facts and theories based on experimental work of diverse character, it may not be amiss to look back to the days of simple things, when in this country experimental work—laboratory work—was almost an unknown quantity. It is worth remembering that the first laboratory of physiology for the use of students in the United States was established in 1871 at the Harvard Medical School, while the first laboratory of physiological chemistry for instruction and research in this country was started here at Yale, in the Sheffield Scientific School, in 1874. In this same year, Sir Michael Foster, at that date a young instructor in University College, London, began the teaching of practical physiology and rudimentary physiological chemistry in England, his being the first laboratory course in these subjects offered in that country.

From these statements it is obvious that experimental work in physiology could have had few followers fifty years ago in the United States. Chemical laboratories, however, were much more numerous, and experimental work along chemical lines was gaining rapid headway at various educational centers, and consequently such work as had been attempted in plant physiology was essentially of a chemical character. Here at Yale the first appointment made in plant physiology was in 1846, at the time when what is now the Sheffield Scientific School was started. The incumbent of the professorship then established was John Pitkin Norton, and the appointment read "professor of agricultural chemistry and animal and plant physiology." It is apparent from the title that he was in reality professor of scientific agriculture, but his training in chemistry and in botany had been unusually broad and thorough for those days. For several years he had worked in chemistry at Yale with Silliman and he had spent one year at Harvard. After this preliminary training, he was two years with Professor Johnston in the laboratory of the Agricultural Chemical Association at Edinburgh and a year in the laboratory of Professor Mulder at Utrecht. Probably no American at that date had ever enjoyed such opportunities for scientific training in agriculture as he had experienced.

While abroad, he had made several contributions—the result of original work—to the British Association at Cambridge which had attracted much favorable comment. Most noteworthy was his study of the oat presented to the Highland Agricultural Society of Scotland, for which he received the prize of fifty sovereigns offered for the best piece of work on the subject. This paper was republished in the *American Journal of Science*, its scope being indicated by the following quotation: "Commencing with the young plant, he followed it through its successive stages of growth and development to its maturity, the many analyses giving the composition of the oat from the different parts of the plant separately, *viz.*, the leaf above and below, the stalk, the knots, the grain, etc., besides the organic constituents of the grain." This without doubt was the most thorough chemical investigation of the oat ever made up to that date.

Norton came to New Haven with the expectation that he would be able to devote much of his time and energy to original investigation, for which he was so admirably fitted, but on returning to America he found himself obliged to play the part of a pioneer if he would help forward the development of scientific agriculture in this country. Unfortunately after five years of arduous work his career was suddenly closed by death.

Norton's successor in the Scientific School was John Addison Porter, appointed in 1852. He was a graduate of Yale, and he had enjoyed a long training in chemistry and physiology under Liebig, so that he had a high appreciation of the importance of agricultural chemistry and its application in the cultivation of crops.

More significant in a way was the appointment in 1856 of Samuel W. Johnson, who had worked for a long period with Liebig, his title being professor of analytical and agricultural chemistry. For many years he gave an annual course of lectures to graduate and undergraduate students of the Sheffield Scientific School upon agricultural chemistry and the physiology of plants. This course of lectures attracted so much attention both here and abroad that he was invited to deliver a course of lectures on these subjects in Washington, at the Smithsonian Institution. Later, in 1868, much of this material was brought together in book form under the title "How Crops Grow," dealing particularly with the chemical composition, structure and life of the plant. This book was followed two years later, 1870, by "How Crops Feed," which likewise gained wide attention. As an illustration of the great value of these two books it is only necessary to add that they were translated into German, Swedish, Russian and Japanese, while the first was also translated into Italian.

Johnson was not preeminent as an investigator. His strength lay in his breadth of knowledge, critical judgment and keen analytical mind, which fitted him well for the service he felt called upon to perform, viz., the development of truly scientific methods for the advancement of agriculture. He was, as you doubtless know, the father of the agricultural experiment stations in this country, and his influence in agriculture was dominant for many years Such original work as he carried on in the field of plant physiology had to do mainly with the fixation of ammonia, nitrification and the assimilation of complex nitrogenous bodies by vegetation I recall a paper published in 1866 which dealt with the nutrition of plants, where, by feeding, under suitable conditions, uric acid, hippuric acid and hydrochlorate of guanine, he found that such amides resulting from the disorganization of protein compounds, as well as ammonia salts and nitrates, are capable of direct passage into the plant and there serve for the reorganization of albumen, etc

I must also refer to William H Brewer, who like Johnson was an early graduate of the Sheffield Scientific School and who for nearly forty years (1864–1903) was professor of agriculture here A student of botany at Heidelberg and of chemistry with Bunsen, later with Liebig at Munich, a student of both sciences at Paris, he was broadly trained in the sciences underlying agriculture Further, from 1860 to 1864 he was associated with J D Whitney on the first scientific survey of California, making a special study of the flora of the state, the results of which were published at Cambridge in conjunction with Sereno Watson in 1876, under the title "The Polypetalae" Brewer was a connecting link between chemistry, botany and forestry for many years and while he did no original work in plant physiology he was one of the influences here that helped to arouse interest in the sciences upon which scientific agriculture depends

Also connected with this earlier generation was Daniel C Eaton, professor of botany in the Sheffield Scientific School from 1864 to 1895 An enthusiastic worker in his chosen field, he trained many men in botany who like their teacher were interested primarily in structure and classification rather than in plant physiology.

It may seem somewhat foreign to the interests of this group of workers to recall these men of earlier times, for they were not, strictly speaking, what we should call to-day students of plant physiology, yet they created an atmosphere here favorable for the growth of knowledge contributory to a clearer understanding of physiological problems in relation to plant life and growth It was natural in this new country that plant physiology should develop gradually from studies related to scientific agriculture Successful agriculture was dependent upon the growth of the crops. If the crops failed it meant disaster to the farmer and to the community, while increase in yield frequently meant prosperity Naturally, therefore, attention was focused largely upon studies which promised help in securing a rich crop, and it was the work of the chemist that was called for mainly

As time went on, however, there gradually developed a more scientific spirit, study for the sake of truth, the gaining of knowledge to broaden the understanding of nature's ways without regard to practical application To-day, the study of plant life by chemical and physical methods is yielding a rich harvest, but in Germany, for example, we look back to such men as Liebig and Ritthausen, from whom in the earlier years came the inspiration and the stimulus upon which present-day progress is more or less dependent, and in this country we may well glance backward to the early workers in chemistry, botany and agriculture who were likewise helpful in preparing the way for the advances in knowledge witnessed in this generation

No better illustration of the scientific value of study and research for the sake of increasing knowledge can be found than in the work of Thomas B Osborne, during the years 1886–1928, as research chemist at the Connecticut Agricultural Experiment Station His life, as you know, was devoted almost entirely to studies in protein chemistry, especially proteins of vegetable origin, his interest in this subject having been stimulated in part by Professor S W Johnson To Osborne and his coworkers we owe much of our present-day knowledge regarding the chemical character and composition of the proteins of different plants, the partition of nitrogen and more specifically the proportion of the various amino-acids present in different vegetable proteins Especially noteworthy was his work carried on with H Gideon Wells, on the anaphylaxis reaction as a means of establishing chemical identity, resulting among other things in the conclusion "that each seed contains several chemically distinct proteins, and that no two seeds, unless very closely related botanically, contain chemically identical proteins"

Equally interesting was the conclusion that there must be an almost infinite variety of vegetable proteins, the anaphylactogenic property of a protein being determined by its chemical structure and not by its biological origin Again, the researches of Osborne and Mendel on the nutritive value of the vegetable proteins have contributed largely toward establishing the close relationship between the chemical constitution of the proteins and their biological value We have come to see that growth in the animal body is dependent upon the presence in the food of certain amino-acids, such as lysine, cystine and tryptophane, these being imperatively needed for the building of tissue and for making good the losses of cellular material. Hence, proteins which are lacking in these indispensable amino-acids, or contain them only in small amounts are physiologically inferior proteins, not fitted to meet the needs for proper growth.

But I must not continue longer. To cultivate research and thus promote the advancement of knowledge, to bring to light a new truth, in whatever the field of endeavor, is to the true scientist one of the great joys of life. As a recent writer (A. V. Hill) has expressed it: "In scientific research we work and work, sometimes for months and years, in digging a tunnel with no apparent results, then suddenly comes the supreme joy of life—daylight begins to glimmer at the end, and in a few minutes we see that nature, after all, has not played us false."

THE NEED OF COOPERATION IN BIOCHEMICAL RESEARCH[1]

By Professor TREAT B. JOHNSON
YALE UNIVERSITY

A CONTINUOUS teaching and research contact with scientific workers in an academic atmosphere, such as has prevailed at Yale for the last thirty years, is an experience not to be enjoyed by many teachers. An active man could hardly fail to have been influenced by what has happened within this period of time, and also benefited by the many associations that such a professional career offers. It has been the writer's good fortune to have enjoyed such an experience, and he is not able to properly express his appreciation for the satisfaction and pleasures which he has enjoyed in many ways during the past thirty-one years through his associations with graduate students and cooperative undertakings, in the promotion of Yale's activities and productions in chemical research. Although it is nearly one third of a century, it has all happened so quickly that it is difficult to realize the significance of the advances that have been made in our knowledge of the field of chemical science and to comprehend the possibilities of discovery in the newer fields of research which have been opened up to the organic chemist within this period of time. There is no doubt that the younger men who have in their control the destinies of the next thirty years of scientific service have before them opportunities for successful accomplishments which are just as promising as the future held out to young investigators at the beginning of this century. We older men do not begrudge these new recruits to our ranks their rich opportunities, but we wish them the best of success, and with the hope that our accomplishments of the past thirty years will have made their course less difficult to follow, their problems easier to understand, and their methods of attack and conclusions more exact and definite.

The last half century has seen a great advance, not only in the development of every branch of the natural sciences, but also in the number of these branches. It has been a growth which has necessarily led to much specialization, but not without great benefit to all the major divisions of the natural sciences.

The names of the new sciences, for example, such as geochemistry, biophysics, biochemistry, astrophysics, psychophysics, and many others, which we have not time to mention here, show that these new subdivisions are merely the overlapping of two or more of the older branches of science. Their fields of operations are the border lines of different sciences where the phenomena of natural interest are dependent on fundamental laws characterizing the special sciences involved. What has been the result of this overlapping?

(1) One result has been a breaking down of the old boundaries of science and a more general recognition of the scope and application of the theories and principles of the science of chemistry. To-day there is no definite boundary between chemistry and physics, between chemistry and crystallography, between chemistry and metallurgy, or between chemistry and technology.

(2) It has meant also that we have developed a highly specialized knowledge which now requires a much broader basis of scientific training than it did thirty years ago. As a result we have been called upon to give more thoughtful consideration to the preliminary training of those who desire to prepare themselves for professional careers and to pay more attention to the proper coordination of fundamental course subjects and to emphasize the dual nature of the major scientific projects now calling for investigation and solution.

(3) And, finally, it has caused to be evolved a new

---

[1] An address delivered at the Conference for Investigators Interested in the Chemistry and Physiology of Plants, at New Haven, Connecticut, June 5, 1931.

program or era of sympathy, understanding, general appreciation of the importance of all research and interchange of ideas between workers in different fields of science. No scientific group of workers can live to-day within itself and accomplish its best work. We are all more or less interdependent and we are living in an age which is changing rapidly, and quick decisions are expected. This urgent demand for prompt solution and more rapid progress is calling for increased concentration on the part of the investigator and a greater amount of cooperation than ever before. Closer organization seems to be the demand of our times, and the bringing together of different workers in the fields which overlap is essential if we are to accomplish our best work.

No science has been more affected in the scope of its interest by these developments than chemistry. The specialized subdivisions of knowledge, such as biology, bacteriology, animal and plant physiology, botany, pharmacology, medicine, surgery, psychology and even some subdivisions of the social sciences, can no longer dissociate themselves from its influences. Chemistry was once confined to a few individuals and used in a few industries only. It is now widely diffused in all scientific undertakings dealing with natural phenomena and is used in practically every industry. No one can study to-day any modern science or branch of technology, mathematics alone excepted, without some knowledge of chemistry. In fact, in a few years' time every person that is considered properly educated will have a smattering of chemistry, and furthermore, no chemist will attempt to be interested and informed in all the several branches of chemistry. Procedures that have suited in the last fifty years will require much modification to meet the growing demands and to suit the next fifty years.

The technical and scientific world was never more interesting to investigators and the public than it is to-day. Discovery follows closely on the heels of discovery, theories and speculations live only for a short time. Industry to-day is in a state of constant strain. Processes that lead to a financial success to-day become impractical or obsolete to-morrow. In the hands of the engineer or technologist lies the secret to-day of success in all our industrial enterprises. Every discovery depends upon previous work. Every stage in the unfolding of knowledge prepares the way for further advance.

The most outstanding development in the biological sciences, from a biological or a chemical point of view, has been the growth of that field of scientific endeavor that we include to-day under the subdivision "biochemistry." It was not, however, until workers in the different biological subdivisions began to realize what chemistry could do to aid in the advancement of the knowledge of their respective subjects that cooperative measures were finally instituted, which led up to the important developments grouped under this new branch of science.

That all vital activity is dependent on chemical reactions is a belief which has influenced the growth of organic chemistry for years. Chemists have been interested for a long time in elucidating the chemical mysteries of the living processes of animals and plants. The French chemist, Lavoisier, in the eighteenth century was one of the first to express an interest in the phenomenon of respiration, and he stated that animal heat results from the action of oxygen. As a result of his postulations the direct method of oxidation was thought for a long time to be the only one to which the phenomenon of respiration could be ascribed. Later, this conception of respiration and fermentation was shown to be untenable when Pasteur, a chemical-bacteriologist, demonstrated that microorganisms could exist and propagate their form without free oxygen. In fact, he went so far as to show that oxygen acted as a poison and was harmful to some of the lower forms of life. We now recognize as a result of his work that this gas must be excluded if anaerobic organisms are to grow and multiply. In fact, Pasteur regarded fermentation as anaerobic phenomenon. To-day these pioneer conceptions of respiration phenomenon no longer hold. Our ideas have been revolutionized by the new discoveries in biochemistry revealing a more exact understanding of cellular oxidation-reduction changes. This has been the result of three broad chemical influences: (1) A better understanding of the chemical composition of cells and their process of metabolism, (2) an advance in our knowledge of the physical chemistry of organic reactions in heterogeneous systems and the experimental conditions affecting intermolecular transformations, and (3) the discovery of the fundamental laws governing all colloidal and interfacial phenomena.

Emil Fischer's classic contributions to our knowledge of the chemistry of proteins and sugars, van't Hoff and Le Bel's brilliant speculations which led up to the modern physical conception of the asymmetry of carbon in organic combinations, and the recent revelations of organic structure and crystal constitution by application of x-ray photography are illustrative examples of the many classic contributions to chemical science which have finally established firmly the architectural theory of the molecular structure of organic compounds. Every branch of natural science which has called upon organic chemistry for cooperation in the development of its border-line problems has been influenced by this structure theory conceived by the early workers in chemistry. The theory of organic structure has been fully substantiated and it has stood the test of experimental science for the past sixty years It is now recognized as being in complete accord with the exactness, precision and regularity of all natural biological phenomena

In other words, chemical-biology, or biochemistry, has assumed a particular distinction to-day as a field of science which gives it a much broader significance and scope of operations than can be ascribed to any single subdivision of science It represents in modern language a community of scientific interests having interdependent relations, and no one of the fields of study embraced under this term can function to-day independently

We can, therefore, no longer divorce chemical from biological reasonings All the branches of biological science are becoming more and more closely connected with the facts and theories of chemistry as new discoveries are made and our technique is improved

If it be admitted that this consolidation of chemical and biological interests is necessary for future growth, and will lead to an increase in our knowledge of natural phenomena, is it not a logical conclusion that the future workers in these related fields should be urged to cooperate more closely in their work, and seek to better understand the view-points of each other—in other words to be able to think and reason together? The contact can not be otherwise than helpful Professor George Barger, of Edinburgh, Scotland, remarked in a recent address as follows "I am convinced that within the limits of administrative possibility the greater the variety of workers brought together the better the results" This is most essential to-day if different workers in two or more correlated scientific fields are not to be deprived of much valuable interchange of ideas, of essential materials for experimentation and new apparatus for developing technique.

This does not mean that the discoveries made by individual and isolated workers who desire or are compelled to work alone will be without value in the final solutions of our many problems We all know that we have scientific workers who are so constituted that they can do their best work independently and will be exceptionally brilliant and capable of contributing largely to knowledge oftentimes in more than *one* scientific field Nothing should be done to interfere with or restrict the activities of such investigators They represent an important unit of our scientific personnel, and many of our soundest conclusions are made under such conditions

One could expand further on the subject of all-around genius, and of the few men who are able to make discoveries of far-reaching effect in whatever branch of science they took up. Notwithstanding all this, it is undoubtedly true that the amount of scientific data made available by such men will be much smaller and less comprehensive than that which is contributed by workers organized on a cooperative basis This has been well illustrated by what has been accomplished within the last six years in the field of tuberculosis research, and many other illustrations could be given to support our thesis.

A biochemist requires to-day a thorough grounding in physiology and organic, physical and colloid chemistry as well as some acquaintance with diverse subjects like botany, and even pathology In fact, the important problems calling for solution to-day demand a close cooperation between chemical laboratories, plantations, forest and field, and require the services of men of considerable intellectual ability, a capacity for careful and sustained observations, and ability to select data with good judgment and a liking for life in open competition.

It is significant that at the present time a steadily increasing number of trained organic chemists consider it worth their while to turn to biochemistry for their future work They are apparently welcomed into the ranks of such service, and the future holds much in store for them The development of chemistry in elucidating the mysteries of living plants and animals is the most attractive field of research for the next generation

Our future investigations will involve the inner structure of matter, radioactivity phenomena, nature of magnetism, utilization of electrical charges, conversion of these into heat and their effect on life itself Progress will be made if our educational system will enable us to develop researchers of intelligence, gifted with the ability to observe, who have a good eye and show skill in manipulation

A great deal is known about the biochemistry of the body, but a great deal is obscure. At present the line of progress seems to lie in the isolation, identification and subsequent synthesis of products produced by cells of the body and plant But how much is actually known about the chemical activities of the vital source of biological phenomena—the living cell? We all realize that we are dealing here with delicate problems, but we are optimistic about the future results. The chemical compounds regulating animal life are being slowly and surely identified and the chemical processes they cause are now being watched and explained. The chemistry of bacteriology, of simple botanical life, of fermentation, of drugs and alkaloids useful for treatment of disease and enzymic processes now form some of the important branches of the science of biochemistry.

To summarize Just as chemistry has permeated every industry, so it has permeated practically every fundamental science In fact, it is not improbable that it may cease to exist as a separate science, just as reading, grammar and arithmetic have ceased to enjoy independent existence. As a result of further cooperation between subdivisions of science, science itself may perhaps become one subject We shall then attain the final objective of all scientific effort

INDUSTRIAL SCIENCE—A GILT EDGE SECURITY[1]

By MAURICE HOLLAND

DIRECTOR, DIVISION OF ENGINEERING AND INDUSTRIAL RESEARCH, NATIONAL RESEARCH COUNCIL

RESEARCH is one of the best forms of security for capital invested in industry Efficient management is another To a trained observer there is a direct relation between the research rating and the security ranking of the leaders of American industry Turn to the financial page of your paper and read the names of industrial companies known as market leaders and you will find a list of those companies best known for their extensive research activities Nowadays the discoveries of science is front-page news The applications of science in industry appear in the business section, while the latest report of the advances of industrial technology are reflected in the quotations on the Stock Exchange In the language of Wall Street, science appears on the financial page, when "the news is out"

Headlines that tell you of the latest happenings in the scientific world are primarily written, not to report the possibilities of prospective increases in profits or dividends, but to acquaint the whole public with facts that picture the march of progress The science story appears on the front page for the reason that the achievements in the field of pure science are changing the face of the world The story of what our scientists are doing and how they are doing it is much more than a story of financial success On the contrary, it is fundamentally a story of advancing civilization, of higher standards of living, increased comforts, better health, easier working conditions, more leisure, in fact, of all the things that lead to the betterment of mankind

One of the most widely read financial magazines circulates a questionnaire periodically to a fixed list of about 1,000 business leaders made up of presidents and presiding officers of corporations whose stocks are listed on the New York Stock Exchange. The winners in the most recent poll of corporation executives places the companies in this order American Telephone, United States Steel, General Electric, Standard Oil, General Motors, Anaconda Copper, Electric Bond and Share, United Corporation, Radio Corporation, Westinghouse Electric and Manufacturing A list of "Who's Who of Science in Industry" would contain the same names, with the exception of United Corporation, a holding company The research activities of these companies have put them in first position, among the leaders of American industry, and research enables them to maintain that position

In the highly competitive struggle for industrial supremacy, the march of science, discovery and invention has so speeded up the advances of technology that a laboratory discovery may mean creation of a new industry, or expansion of one and losses for another To-day's discovery in the field of scientific theory inevitably leads to application in the practical field of business to-morrow The slow process of evolution of industry by improvements in mechanical equipment has given way to revolution of manufacturing processes by research Within the last year or two many industries have felt the rising tide of competition, and not a few have slipped from their moorings The very foundation of industries, unless they be anchored in the bedrock of pure science, threaten to be carried away They carry on under the silent menace of the attack of competitors undermining the structure with the levers of applied science.

This year's reports of some of the most progressive manufacturing corporations devote a half page of text or less to the finances of the company. The balance of the report is concerned with the achievements in science, invention and new processes and products which have grown out of them The spirit of these reports is typical of the far-sighted policies which guide many of our successful industrial corporations. There is no more significant characteristic of present-day corporation management than its efforts to peer into the future, and their attempts to forecast future trends.

Leading bankers also have begun to realize that it is not enough to know the commercial and financial condition of an industry; they must also know the technical assets which lie behind the balance sheet, because plant, process and product may fall "victims" to competitive research

At this moment analysts are busy searching out basic factors; statisticians present arrays of factual data as proof of their theories, and bankers keep daily tab on the shifting currents. They watch the surface ripples of industry and commerce for a sign as to which way the wind is blowing. Statistics, barometer charts, market letters, business cycles, carloadings as indicators of the state of industry and commerce are accessories after the fact. They are based on past performance. They are about as good as "racing form" in predicting the performance of any dark horse in the race for industrial supremacy.

---

[1] An address before the American Association for the Advancement of Science, at Pasadena, California, June, 1931.

Forecasting industrial futures, by a study of the present trend of research, will be reduced by trained observers to the same formulae and computations which govern the transactions in cotton and wheat futures on the New York Exchange. In the not far distant day of "the technical or science audit" of an industrial company, barometer charts based on technical, not the commercial, state of industry will appear. The technical audit, as a supplementary safeguard to the protective devices now used in long-term industrial loans, seems to be inevitable development in investment banking.

Some of the factors behind the scenes of the company balance sheet which play important rôles are the technical state of the art, the plant, the processes and the product. The attitude of the management toward research, available research facilities and technical advances in foreign countries, which may influence the domestic market, all have a meaning to the eye of a skilled observer. These may be translated into the language of dollars and cents—deficits or profits, dividends or assessments.

In this age of mass production, big volume, quick turnover, the average American business man wants action. A quick return. His conception of research is that it is something like a mysterious box of black magic, in which you should be able to put a research appropriation in the slot, turn the crank, and dollar dividends would roll out. Compare that picture with the vision and business judgment which financed the "speculations" of academic-minded Ph.D.'s, and were rewarded with the control of the dye markets of the world by Germany. It took fifteen years of research and an expenditure of 29,000,000 gold marks to produce the formula for aniline dyes, a good illustration of "patient money."

Men called dreamers, seekers after truth, pushing back the frontier of knowledge, making fundamental investigations of sound in the Bell Telephone Laboratories, are the first-line defense in safeguarding the capital investment of the largest single industrial enterprise in the world. Six thousand research workers are kept in the field as prospectors on the frontiers of industry at a cost of twenty million dollars a year. Years of toil on the borders of the unknown may be rewarded with a mere handful of nuggets—in the form of new facts. But the discoveries of these new facts has shaped the destiny of old industries and created new ones. Pure science investigations to increase the volume and to refine the quality of sound for long-distance telephony yielded unexpected dividends. The minted winnings of research produced much fine gold, while further reduction brought out by-products from the lesser ore. One of these, fashioned by applied science to the pattern of a specific need, laid the foundation for the talking movies, and put the silent pictures on the shelf!

In those early days the moving picture industry did not support a single research laboratory within its own ranks. The industry is still paying tribute for an "imported technology." Sperry, of gyroscope fame, developed a high intensity arc lamp which is actually "brighter than the sun" and brings California sunshine to Long Island studios "sets"—with the snap of an electric switch. Such is the power of this man-made light that the motion picture screen is brought close to the movie fan in the last row of the highest gallery of our largest cinema cathedrals. Colored movies came out of the laboratories of two Boston Tech professors, whose patient plodding in the physics and chemistry of light and color enabled them to "break into pictures." They find themselves a little bewildered perhaps, in the world of make-believe, these advocates of truth who practice in the court of nature, where there are no appeals, nor any exceptions granted. Their names have never "gone up in electric lights." The record of their achievement lies buried in laboratory notebooks, transitory guideposts on the path of progress. To-day there are more experimental laboratories on the movie lot than studios, and there are more technicians in Hollywood than actors.

The moving picture industry, working with a dynamic medium, is growing up, technically speaking. This industrial prodigy is one of the youngest in the large family of science-aided industries to emerge from the laboratory incubator, where the "children of science" are born.

It is almost axiomatic in the experience of the division of engineering and industrial research, N. R. C., that new industries, with processes in the state of flux, and with management unhampered by tradition and prejudice, are the most likely prospects for research. Radio and commercial air transport are also good illustrations of the lusty brood of the twentieth century generation of industries which have opened the door of opportunity with a science key!

Part of the broad policy of up-to-the-minute management of our industrial corporations is the eagerness with which far-sighted executives watch the developments of science. No advance in industrial technology is overlooked which may be turned to good account. With news reels bringing the latest "flash" reports from every corner of the science world, with popular science radio talks recording almost daily the triumphs of the test-tubes, in the battle for industrial supremacy, science is working in glass houses—that all may see. Industrialists not content with watchful waiting have become some of the most substantial contributors to the advance of pure science as well as to the technology of their own industries. Every year more and more laboratories are being set up, and the scope of their inquiries is steadily broadening. A National Research Council survey of 1920 lists 575 laboratories. By 1927 there had been a hundred per cent. increase, with over a thousand laboratories operating, as an integral part of the private industrial companies. To-day there are over 1,600 industrial laboratories. They serve as the far-flung outposts of American industry on the frontiers of knowledge.

To prophesy that any addition to the body of human knowledge will never be of any practical value is extremely hazardous. Who will say that Einstein's theory of relativity may not be the bedrock foundation on which a dozen industries as yet unborn may be erected in 1975? Who will be so rash as to predict the final result of the recent meeting of the world-renowned mathematical genius with Michelson and Millikan, both of them Nobel prize winners in physics? Hale, working in his "laboratory on the sun," brought down to earth helium, which has since been used in the building of fireproof dirigibles which have spanned continents and crossed the seven seas. Hardly two quarts of helium was known to exist on earth as late as 1914. Sometime ago this rare gas, discovered by dreamers gazing at the stars, was a cure for "bends," a temporary paralysis caused by working at great pressures which overcomes men burrowing in the earth and diving into the depths of the sea.

Science owes much to the modern tendency of the increasing use of science in industry and the debt is steadily increasing. The fruits of the applications of science provide the seeds with which to endow the planting of new gardens in which pure science may come to full flowers. Industry profits immeasurably by its vision in this direction. The testimony of the executive officers of a thousand representative industrial corporations, rated in the million-dollar class, is conclusive that research is a paying investment. Here a few typical statements are presented.

The president of a chemical manufacturing firm answers in no uncertain terms. "Research," he says, "is the one tool by which, within the short space of 12 to 15 years, American chemists, engineers and physicists have established in America an organic chemical industry, the magnitude of which is so great and the quality of whose product is so good that it is the marvel of our European competitors. In this field, the country to-day is practically self-supporting, as compared with the situation before the War when it was practically dependent upon European supplies."

In a different field of industry consider this statement made by the treasurer of a large textile plant, "We can figure that our leading profits are from 100 to 200 per cent. of the amount spent for research."

Another executive who has apparently determined his profits from research closely (he is vice-president of a rolling mill and steel concern) declared: "For every dollar spent in true research we have reduced costs and increased net revenue by at least $100." A particularly enthusiastic pulp and paper manufacturer has found his research laboratory "the biggest dividend-paying department."

The average annual premium paid by this representative cross-section of American industry is 1.3 per cent. of capital investment. Research appropriations are regarded by these executives as industrial insurance against competition. As an average for all industry, 31 per cent. of the investment in research is directed towards reducing production costs, 34 per cent. to improving the quality of products in service, and 20 per cent. to developing new fields of application, while the balance of 15 per cent. is used for developing new materials and products. The principal emphasis of research programs is on developments and improvements that will gradually improve production and increase dividends for the long pull. The public as a whole is the greatest gainer of all. The ultimate dividends of research are passed on to the consumer in reduced costs, improved quality and service and in dividends.

Industrial corporations, like industrial securities, may be divided in two major groups—preferred and common. Preferred securities attract the investor, primarily interested in the safety of his principal and a steady and assured income. Common stocks are conceded to be speculative. The public interest in investments in American industry is much larger than most of us realize. It has been estimated that there are fifteen million stockholders of industrial securities. No single investor in American Telephone in the legion of 550,000 stockholders in that company owns 1 per cent. of the stock. U. S. Steel, General Motors, General Electric and Standard Oil pay dividends to 600,000 or more "individual bankers" who have chosen to share their fortunes with these "industrial giants." Recently an investment trust was organized in which investors were invited to share in futures of a representative group of industrial corporations, each of which is an acknowledged leader in its field. Every company in the group operates a research laboratory as an integral part of the company organization. The names of forty companies read like a blue book list of "Who's Who in Industry." The "and why" is summed up in the one word "research." The sponsors of this "trust" look upon research as an industrial security in this way. "Scientific research as it affects the industrial survival and competitive race of great companies, whose histories are measured by decades rather than by years, is a method—not a catchword, and in its place it is as important as methods of selling, production or accounting, although not quite so immediately effective." That statement would indicate that investment bankers and their customers, the investors in industrial securities, have begun to appreciate the meaning of "patient money."

Banking also takes a first-line position on the frontier of industry. The adventurous spirit of research opens up new territory, banking consolidates the position. The enterprise of research workers stakes out the claim, banking supplies the capital, to bring out the pay dirt. Research is a guarantee to the banker of invested capital, his insurance against loss in new enterprises. Research blazes a trail as the vanguard of industrial progress; banking builds a road to connect the frontier of industry with the main arteries of commerce.

OBITUARY

MEMORIALS

IT is reported in *Eugenical News* that at Neu Titschein, Czechoslovakia, near where Gregor Mendel was born, there was held on July 5 a celebration at the unveiling of a Gregor Mendel monument. The program was as follows: Professor Dr. Oswald Richter, of Brunn, gave an address on "Gregor Mendel and His Home," and Hofrat Professor Dr. Erich Tschermak-Seysenegg, of Wien, on "Mendel's Laws of Heredity and Their Significance for Plant Breeding." An address of welcome by Burgomaster Dr. Ernst Schollich, and an address by Professor Dr. Frimmel, of Brunn, was followed by the unveiling and a chorus. At 4 P. M. there was an "Ausflug" by auto to Mendel's birthplace in Heinzendorf.

THE review *Scientia* pays tribute to the memory of its late director, Dr. Eugenio Rignano, by founding a Eugenio Rignano Prize, of the value of 10,000 lire, to be conferred by international competition upon the author of the best essay on "The Evolution of the Notion of Time."

RECENT DEATHS

PROFESSOR EDWARD S. KING, professor emeritus of astronomy at Harvard University, died at his home in Cambridge on September 11 at the age of seventy years.

PROFESSOR RUSSELL LOVE MORRIS, professor of engineering at West Virginia University, died on September 1, at the age of sixty-two years.

MR. COURTENAY DE KALB, well-known mining engineer and former professor of mining engineering at the University of Missouri and the University of Alabama, died on September 2 at the age of sixty-nine years.

MR. EVERETT JOEL HALL, formerly professor at the School of Mines at Columbia University, died on September 3 at the age of fifty-four years.

DR. HENRY T. MCKINNEY, professor of education at Bethany College, died on August 30, following a minor operation. Dr. McKinney, who was treasurer of the West Virginia Academy of Science, was fifty-two years old.

SIR THOMAS STANTON, superintendent of the engineering department of the National Physical Laboratory, England, was drowned in Pevensey Bay, Sussex, England, on August 31.

DR. ARTHUR SIMARD, professor of surgery at Laval University, Canada, and past president of the College of Physicians of the Province of Quebec, died on September 3. He was sixty-three years of age.

PROFESSOR J. W. HINCHLEY, professor of chemical engineering in the Imperial College of Science and Technology and secretary of the Institution of Chemical Engineers, died on August 13 at the age of sixty years.

SCIENTIFIC EVENTS

THE AMERICAN CELEBRATION OF THE ANNIVERSARY OF THE INVENTIONS OF MICHAEL FARADAY AND JOSEPH HENRY

THE one hundredth anniversary of the discovery of electromagnetic induction will be observed by an elaborate display sponsored by the New York Museum of Science and Industry and the Radio-Electrical World's Fair. *The New York Herald Tribune* reports that the display, honoring the achievements of Michael Faraday, the English physicist, and Joseph

Henry, the American experimenter, will be presented at Madison Square Garden throughout the week of the Eighth Annual Radio-Electrical World's Fair, from September 21 to 26, inclusive This observance will be *one of the major American tributes to these men* who are being honored in celebrations throughout the world during September.

Exact replicas of the Faraday and Henry inventions, complete in every detail and prepared after many months of work, will be shown to the public for the first time at the fair

It was in the autumn of 1831 that Michael Faraday discovered that by moving a magnetized cylinder inside a copper wire coil an electric current flowed through the coil Operating independently of Faraday, but at the same time, Joseph Henry, professor of engineering at Princeton University, was accredited with discovering exactly the same thing A century has passed and the radio and electrical industries, born in the laboratories of Faraday and Henry, have grown to tremendous proportions

On September 21 the centennial of Faraday's discoveries will be celebrated at the Royal Institution of Great Britain in London Starting on the same date and continuing throughout the week America's tributes to Faraday and his American contemporary, Joseph Henry, will be made at the Radio-Electrical World's Fair

The display will contain collections of Faraday and Henry objects Many thousands of dollars have been spent in reproducing their inventions in exact replica The Faraday group includes the Englishman's famous meter, magnet and ring The Henry group includes the American inventor's electromagnet of 1829, the quantity magnet, electromagnetic motor, Morse recorder, galvanometer, commutator, armature, spiral, inductance coil and large electromagnet Also in this group will be Sturgeon's electromagnet of *1826* in exact replica Sturgeon is said to have caught the theory of electromagnetic induction earlier than Henry and Faraday, but his device was not widely accepted as proving the theory.

A second group of displays known as the electronics exhibit will also be shown at the Radio-Electrical World's Fair. The magic of electricity will be demonstrated in the museum's high-frequency demonstrations. Resonance is the subject of the fourth group of displays in the museum exhibit

THE ANNUAL MEETING OF THE OPTICAL SOCIETY OF AMERICA

THE sixteenth annual meeting of the Optical Society of America will be held at Rochester, New York, from October 22 to 24. In addition to the usual program of papers contributed by members on their own initiative, the meeting will include the following:

(1) A session devoted to invited papers on Aerial Photographic Mapping These will include: I. C Gardner, "The Optical Requirements of Airplane Mapping"; Earl Church, "Analytical Methods in Aerial Photogrammetry", C H. Birdseye, "Photographic Mapping Instruments and Methods", Edward H Cahill, "The Brock Aerial Mapping Process", H L Cooke, "Preparation of Relief Maps from Aeroplane Photographs"; Hamilton Rice, "Air Methods in the Exploration of Difficult Country—The Branco Uraricuera-Parima River of Brazilian Guayana Expedition, 1924–25" (illustrated by motion pictures), Brasilian Guayana Expedition, 1924–25 (illustrated by motion pictures)

(2) A session devoted to invited papers on "Optical Problems in the Motion Picture Industry" The details will be announced in the final program

(3) A complimentary dinner at the Bausch and Lomb plant, followed by an exhibit illustrating operations of the plant

(4) Annual society dinner, followed by a trip to the University of Rochester to see the new buildings there

(5) Presentation of the Frederic Ives Medal for 1931

Sessions will be held at the Hotel Sagamore, the Auditorium of the new Research Laboratory of the Eastman Kodak Company, and the Physics Building at the University of Rochester

A program of the meeting containing abstracts of contributed papers will be mailed to members about October 10

The secretary was instructed by the executive council to place on all announcements of meetings that the society reserves the right of original publication of all contributed papers presented at its meetings

The meeting will be open to non-members as well as members of the society. All interested persons are invited to attend Non-members who desire to receive the advance program and final notices in regard to the meeting, hotel headquarters, etc, should address their requests not later than October 3, 1931 to L. B Tuckerman, secretary, Optical Society of America, Bureau of Standards, Washington, D C.

THE MUSEUM OF ANTHROPOLOGY OF THE UNIVERSITY OF CALIFORNIA

ARRANGEMENTS have been made for the removal of the University of California Museum of Anthropology from San Francisco to Berkeley.

It has been found necessary to move the museum from San Francisco because the old building in which it is housed must be torn down to make way for the University Hospital's outpatient department adjoining the hospital building at Second and Parnassus Avenues, which will be constructed at a cost of $500,-

000. It is believed that the museum will be more valuable as a teaching aid in Berkeley, where it will be convenient for the students. It is planned to house the collection in the old civil engineering building, which will be vacated with the completion of the new engineering group near Hearst Avenue.

The Museum of Anthropology, which is devoted to the history of man and his works, was founded by Mrs. Phoebe Apperson Hearst in 1901, and was opened to the public in 1911

The chief collections in the building, which will have to be moved by truck across the San Francisco Bay, are: California Indian, 40,000 specimens, Egyptian, 21,000, North American Indian, 14,000, Central American, 3,500, African, 600, European, 1,385; Graeco-Roman, 5,000, Asiatic, 700, Philippine Islands, 1,000, Australia and the Pacific Islands, 2,200, Peruvian, 10,000, South American, 2,500, etc There are in addition, 9,000 negatives of pictures, 2,416 phonograph records of Indian languages and music, 4,747 records concerned with physical measurements, 210 paintings, 3,575 lantern slides for lectures, and hundreds of maps, engravings and miscellaneous objects. The library consists of some 2,600 volumes While the museum has always been cramped for space, much interesting material being stored away and never exhibited, the building now to be occupied is even smaller than the old one, and is not well adapted to museum needs

THE ONE HUNDREDTH ANNIVERSARY OF THE LEEDS SCHOOL OF MEDICINE

No fewer than sixteen British and Irish universities, according to the London *Times*, were represented at the celebration at the University of Leeds on July 1, of the one hundredth anniversary of the founding of the Leeds School of Medicine, which is continued in the faculty of medicine in the present University of Leeds. Almost all the university delegates were men of national reputation, and the Royal Colleges of Medicine and Surgery in England, Scotland and Ireland, the great hospitals, medical schools in London, the General Medical Council, state departments, as the Ministry of Health and the Board of Education, the medical services of the Navy, Army and Air Force, and a variety of learned and professional institutions also honored the occasion by nominating special representatives who were men of the highest distinction in their respective fields.

The Duke of Devonshire, chancellor of the university, in welcoming the delegates from the universities and medical schools of Great Britain and Ireland and the representatives of the departments of state and of the societies, associations and learned institutions interested in medicine, said:

That the university had special pleasure in seeing present a representative of the Society of Apothecaries (the Master, Lieutenant-Colonel C. T. Samman) and of the Royal College of Surgeons (Mr Fagge). To both of those institutions the Leeds School of Medicine owed much. To one of them, the College of Surgeons, the school had in part repaid its debt by providing it for the past four years with its president, Lord Moynihan, a former professor in the school and the first of its students to occupy the presidential chair of the college

The predominant aim of the Leeds School had always been to turn out soundly trained professional men. In this he thought it might be that they had not been unsuccessful The continuous and intimate association of the school with the Leeds Infirmary had been the prime source of its success, but it was to be noted that the governors of the infirmary had all along been a body quite independent of the school Without their loyal and sympathetic cooperation the work of the school might have failed in its object Since the school of medicine became the medical faculty of the university the medical departments had grown in extent and efficiency and the reputation of the school had steadily increased Sir Algernon Firth and the late Lord Brotherton had enriched its resources by their generous benefactions, and those responsible for the school believed it was by no means at the end of its development

The vice-chancellor, Sir James Baillie, claimed for the Leeds School of Medicine the merit of having utilized with success the labors of the founders of medical science, of having adapted their methods and experience to the needs of a new situation, and of making their own distinctive contribution to the expansion and advancement of medical knowledge.

Sir Humphry Rolleston, who was the representative of the University of Cambridge, replied on behalf of all the visiting delegates, tendering hearty congratulation to the Leeds Medical School on the attainment of its centenary and saying that the school had made itself famous, first in preventive medicine, then in clinical and curative medicine, and particularly in the evolution of abdominal surgery. The Leeds School had the distinction of initiating the study of the prevention of industrial disease and was the first to blaze the trail in this country.

Among the honorary degrees conferred were the following:

The degree of doctor of laws on Dr Jane Walker, medical superintendent of the East Anglia Tuberculosis Sanatorium, Suffolk, a native of Dewsbury, and the first Yorkshirewoman to enter the medical profession; Dr A G Barrs, emeritus professor of medicine at Leeds and for over fifty years connected with the school of medicine, Sir John Bland-Sutton, consulting surgeon at the Middlesex Hospital and noted in anatomy, pathology and surgery, human and animal; Lord Dawson, of Penn, president of the Royal

College of Physicians, and Sir George Newman, chief medical officer, ministry of health

The degree of doctor of science was conferred on Walter Morley Fletcher, of the Medical Research Council, and Sir Frederick Gowland Hopkins, the physiologist and authority on biochemistry

SCIENTIFIC NOTES AND NEWS

DR. WALTER S. ADAMS, director of the Mount Wilson Observatory, has been elected president of the American Astronomical Society. Dr Willem de Sitter, professor of astronomy and director of the observatory at the University of Leyden, has been elected to honorary membership in the society.

DR. ROBERT A MILLIKAN has been elected a senator of the national council of the United Chapters of Phi Beta Kappa

THE Fukien Christian University, China, has established three scholarships in honor of Professor Maynard M Metcalf, Professor C G Rogers and Professor R A Budington, "in recognition of their long years of famous pieces of research in biology and decades of teaching"

MR MORRIS GOODKIND, of the New Jersey State Highway Department, has been awarded a medal by the American Society of Civil Engineers for the design of the bridge recently erected over the Raritan River near New Brunswick

THE president and fellows of Trinity College, Oxford, have elected to an honorary fellowship Sir Henry A Miers, from 1895 to 1908 Waynflete professor of mineralogy at Oxford

PROFESSOR OTTO WARBURG, director of the Kaiser Wilhelm Institut in Dahlem, near Berlin, was awarded recently, by the faculty of medicine of Würzburg, the prize established by Dr Josef Schneider, ophthalmologist of Milwaukee, together with a gold medal

THE Chalmers Medal of the Royal Society of Tropical Medicine and Hygiene, founded in memory of the late Dr Albert Chalmers, has been awarded to Dr N. Hamilton Fairley for distinguished original work in tropical medicine, particularly in the field of serology of helminthic infections.

THE Adams Prize of the University of Cambridge, valued at about $1,000, which is awarded every two years for an essay on some branch of pure mathematics, astronomy or other branch of physical science, has been awarded to Mr A. S Besicovitch, fellow of Trinity College The subject was "The Theory of Almost Periodic Functions"

THOMAS M. DUGAN, of McKeesport, Pennsylvania, secretary of the American Society of Sanitary Engineers, was made president at the annual meeting in Richmond, Virginia. He succeeds R McGonegal, of Washington J. F Doud, of Cincinnati, was elected treasurer, and James R Walker, of Waterbury, Conn., was reelected librarian

PROFESSOR CHARLES SCOTT PORTER, associate professor of mathematics at Amherst College since 1929, has been appointed acting dean of the college He has succeeded Professor Geoffroy Atkinson

DR. ERNST GELLHORN has been promoted from associate professor to professor of physiology at the University of Oregon

DR. NEIL E STEVENS, of the Bureau of Plant Industry of the U S Department of Agriculture, has been appointed lecturer in the history of botany at the George Washington University

DR. W S COLE has been appointed instructor in the department of geology at Ohio State University

DR. C H GORDON, professor of geology and mineralogy at the University of Tennessee since 1907, having passed the age of 74 years, has been retired and given the title of emeritus professor of geology

MR. O T KREUSSER, director of General Motors Proving Ground and of engineering tests of the Fisher Body Corporation, has been made director of the Museum of Science and Industry in Chicago

DR. EDWIN A ZIEGLER, senior forest economist in the U. S Forest Service, has been appointed director of the Pennsylvania State Forest Research Institute.

DR. HENRY A BARTON, assistant professor of physics at Cornell University, has been made executive secretary of the American Physics Institute

DR. ALAN STONE has been appointed a member of the staff at the U S. Bureau of Entomology as a specialist on mosquitoes and will take charge of the collection of these insects in the U. S National Museum, succeeding the late Dr Harrison G Dyar. In the interval since Dr Dyar's death, Mr. C T Greene has taken over the identification of mosquitoes in addition to his other work on Diptera

DR. HENRI BRASSEUR, of Belgium, who has received his fourth consecutive fellowship, will work for three months at the California Institute of Technology with Dr. Linus C Pauling, who was the first winner of the Langmuir Prize.

W. J. HEASMAN, of Trinity Hall, and G. J. Kerrich, of Christ's College, have been appointed, respectively, senior and junior curator of the museum of zoology, the University of Cambridge.

Dr. Frank Samuelson Fellows, past assistant surgeon of the U S Public Health Service, has been detailed to the Office of Indian Affairs as district medical director for Alaska to begin supervision for the first time of health work among the natives. He will leave Seattle on October 1 for Juneau, which will be his headquarters.

Dr. Cornelius Lanczos, of the University of Frankfurt, has been appointed visiting professor of mathematics and mathematical physics at Purdue University

Dr. James Ewing, professor of pathology at the Cornell University Medical College, has recently returned from Paris, where he attended the International Congress of Radiology

Dr. G F McEwen has been appointed chairman of the newly created committee on evaporation from free water surfaces of the American Geophysical Union. The committee will give particular attention to investigations of problems of evaporation from the surfaces of lakes, reservoirs, seas and other exposed bodies of water.

The American Oil Chemists Society will hold the next meeting at the Congress Hotel, Chicago, Illinois, on October 29 and 30.

The second international congress of Orientalists since the World War met at Amsterdam, Holland, on September 7 The first meeting was held at Oxford. Those in attendance included a number of Americans, Indians and Japanese, as well as many Europeans. A new feature of this congress was an autonomous section for the discussion of Greek papyrology, which was attended by those who participated in epigraphic and excavation work in Assyria, Palestine, Egypt, Persia and Asia Minor under the leadership of Professor James H Breasted, director of the Oriental Institute of the University of Chicago They include W. F Edgerton, H H Nelson, G. Holscher, K. S. Sansord and P L O Guy, all of the institute. The congress in general devoted itself to the study of all Oriental civilizations, but it was subdivided into several divergent groups, arranged geographically, for the study of China, Japan, India, Persia, Arabia, Asia Minor and Egypt, and chronologically for the study of Egyptology, Assyriology, Indology and Old Testament Islam. Among the most prominent Orientalists who took part in the discussions of the congress were Professor Littmann and Dr Ernest Herzfeld, of Germany, Professor P. Pelliot and Professor L. Massignon, of France, Professor J. Capard, of Belgium, Professor C. A. Nallino, of Italy, Professor D. S Margoliouth, of Oxford, and Professor J. J. L Duyvendak and J. P. H Vogel, of the University of Leyden. Professor C Snouck Hurgronje, of the University of Leyden, who was responsible for the resumption of the sessions of the congress in 1928 after they had been interrupted by the World War, was the presiding officer.

The twenty-fifth anniversary of the founding of the Vineland Laboratory of the Training School at Vineland, New Jersey, was celebrated from September 3 to 5 Professor Henry H. Goddard, professor of abnormal and clinical psychology at Ohio State University, was the guest of honor Dr. Goddard was director of the laboratory at the school from the time of its founding in 1906 until 1918, when he left to take charge of the Ohio Bureau of Juvenile Research. On the evening of September 3, E. R Johnstone, director of the school, gave an address on "The Institution as a Laboratory." On Friday morning the address by William J. Ellis, on "Research in Public Welfare," was followed by an address by Professor Arnold Gesell, professor of child hygiene and director of the psychological clinic at Yale University, on the "Study of Genetic Psychology" There was a reception in the evening. On September 5, the last day of the celebration, Dr Edgar A Doll, director of research at the school, gave an address on "The Outlook for Further Research." In the afternoon, Earl Barnes spoke on "Child Research and Social Progress" The address delivered by Dr. Goddard in the evening was followed by a smoker.

A conference of the Association of Western State Engineers has been called for October 28, 29 and 30 in Sacramento, California. Subjects which are listed for discussion include "Federal and State Policies with respect to Control of Water," "Forethought in Planning the Development of Water Resources" and "Conservation and Administration of Public Domain." In addition to official state representatives from Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington and Wyoming it is expected that official representatives of the following federal departments will be in attendance the Geological Survey, the Federal Power Commission, the U. S. Army, the Department of Agriculture, the Reclamation Bureau and the Forest Service.

The committee on scientific research of the American Medical Association has made a grant of [illegible] to Vanderbilt University School of Medicine to aid [illegible] research on syphilis. These investigations are [illegible] carried out under the direction of Dr. R. S. Cunningham.

AT the annual meeting in July of the trustees of the Beit fellowships for scientific research tenable at the Imperial College, South Kensington, which were founded and endowed in 1913 by the late Sir Otto Beit, Sir Campbell Stuart was appointed chairman of the trust, and Sir Alfred Beit a trustee, both in succession to the founder of the fellowships. New fellowships of the value of £250 a year, and tenable for two years, beginning in September, 1931, were awarded to Mr William Henry Wheeler, formerly of the Luton Modern School, the University of Cambridge, and the Imperial College, for research on the effects of electric and magnetic fields upon gaseous explosions and detonations, and to Mr Joseph Ivan Armstrong, formerly of the Royal Belfast Academical Institute, Queen's University, Belfast, and the Imperial College, for research on the respiration of fungi, with special regard to inorganic nutrition

THE Medical Research Council of London announce that they have made the following awards of Dorothy Temple Cross fellowships for 1931–32, under the terms of the benefaction in that name for research fellowships in tuberculosis: Dr Charles Allan Birch, senior medical registrar and tutor, Royal Infirmary, Liverpool, Roy Lars Vollum, demonstrator in pathology, University of Oxford. Dr. Birch has received a fellowship for the study of problems of tuberculosis at industrial centers in the United States. Dr. Vollum will study recent developments in methods for the investigation of tuberculosis in Germany and Austria. The fellowship awarded last year to Lieutenant Sidney Malcolm Burrows, late clinical assistant, tuberculosis department, St. Thomas's Hospital, has been renewed for a further year.

BETWEEN August 31 and September 3, 1931, an archeological conference was held at Vermillion, South Dakota, under the auspices of the University of South Dakota. Archeologists from Colorado, Iowa, Nebraska, Minnesota, Michigan, North Dakota, South Dakota, Wisconsin and the Smithsonian Institution were present, and each presented a brief review of the archeological situation in his area. Emphasis was placed upon problems and cooperation in the Upper Missouri River drainage and adjacent regions The clear distinction between historic (documented), proto-historic (containing evidence of European contact), and prehistoric (strictly aboriginal) sites and cultures was strongly recommended in future work. Detailed discussion of field problems, aided by examination of sample collections of artifacts, brought about a keen appreciation of the interrelationship of the culture problems of this and adjacent regions. Through the courtesy of Dr. W. H. Over, certain members of the conference later visited a number of strategic sites in southeastern South Dakota.

DR. EDWARD R WEIDLEIN, director of the Mellon Institute of Industrial Research in Pittsburgh, has announced that an industrial fellowship for research on moisture-proofing and grease-proofing paperboards used in cartons and boxes has been established in that institution by the Robert Gair Company, of New York City. Dr Marion D Coulter has been appointed a fellow of the institute, to conduct these scientific investigations. He is a specialist in organic chemistry, and from 1925 to 1930 he held a Mellon Institute fellowship for the study of certain problems in cellulose technology.

THE British Committee of Award of the Rhodes traveling fellowships announces that it has appointed Alfred Maurice Binnie, university demonstrator in engineering science at Oxford, Philip Aislabie Landon, fellow of Trinity College, and Nevill Henry Kendal Aylmer Coghill, fellow of Exeter College, to Rhodes traveling fellowships for 1932

AFTER a two months' cruise in Alaskan waters on his yacht *Arminia*, General W. W. Atterbury, president of the Pennsylvania Railroad, who was accompanied by Mrs Atterbury and two of their sons, has returned to Philadelphia with a collection of bird and mammal specimens for the Academy of Natural Sciences of Philadelphia. These include fur seals and sea lions, which the academy hopes to use in animal life groups to be erected in the North American Hall of its Free Natural History Museum, and a number of sea birds common to that part of the world which were secured as material suitable for a "bird rock" exhibit showing gulls, cormorants, auklets, puffins, terns and guillimots as in their native surroundings. The party sailed from Vancouver on June 30, and after visiting Kadiak and other islands, headed west for the Pribilof Islands in Bering Sea, the home of the great herds of fur seals. On the return journey to Sitka, Harry J. Lance, Jr, of the department of taxidermy at the academy, accompanied the party to assist in securing and preparing specimens.

WE learn from the *British Medical Journal* that the Sir Charles Hastings Clinical Prize, which consists of an illuminated certificate and a money award of fifty guineas, is again open for competition in respect of 1932. The following are the regulations governing the award: (1) The prize is established by the Council of the British Medical Association for the promotion of systematic observation, research and record in general practice; it includes a money award of the value of fifty guineas. (2) Any member of the association who is engaged in general practice is eligible to compete for the prize (3) The work submitted must include personal observations and experiences collected by the candidate in general practice, and a high order of excellence will be required If no essay entered is of sufficient merit no award will be made. (4) Essays, or whatever form the candidate desires his work to take, must be sent to the British Medical Association House, Tavistock Square, London, W C 1, not later than December 31st, 1931, and the prize will be awarded at the annual general meeting of the association to be held in London in July, 1932 (5) No study or essay that has been published in the medical press or elsewhere will be considered eligible for the prize, and a contribution offered in one year can not be accepted in any subsequent year unless it includes evidence of further work. (6) If any question arises in reference to the eligibility of the candidate, or the admissibility of his or her essay, the decision of the council on any such point shall be final (7) Each essay must be typewritten or printed, must be distinguished by a motto, and must be accompanied by a sealed envelope marked with the same motto, and enclosing the candidate's name and address (8) The writer of the essay to whom the prize is awarded may, on the initiative of the science committee, be requested to prepare a paper on the subject for publication in the *British Medical Journal* or for presentation to the appropriate section of the annual meeting of the association. (9) Inquiries relative to the prize should be addressed to the medical secretary.

FORTY-SIX species of birds that inhabit the Himalayas have been received by the Roerich Museum, New York City, in the first group of ornithological collections to be sent from Urusvati, Himalayan Research Institute of the Roerich Museum, at Naggar, Kulu, Western Himalayas The species include the griffon, giant mountain bird of prey, the sacred crane of India, the lammergeyer or bearded vulture, the horned owl, the moorhen, hoopoo, sun birds, orioles, rose-fringed parrots, the long-tailed paradise fly-catcher and the monal, whose feathers shade from copper green and purple into a light brown tail The birds were obtained by the two biological expeditions sent out under Dr Walter Koele The first went through the Kulu Valley and Lahul, across the Rothang Pass The second went into Rampur Bashahr through the Sutlej Valley An ethnographic-archeological-linguistic expedition is also being conducted in Lahul by Dr George Roerich

DISCUSSION

THE CONTROL OF PREDATORY MAMMALS

THE United States Bureau of Biological Survey, in the attempt to control predatory mammals and obnoxious rodents, has adopted policies which have caused the naturalists and conservationists at large grave concern for some years As far back as 1924, the American Society of Mammalogists, at the annual meeting held in Cambridge, April 15–17, protested against the survey policy of extensive campaigns of predator destruction, and at subsequent annual meetings the mammalogists have maintained a practically unanimous stand against the field practices of the survey as far as they relate to drastic control measures

Far from heeding what has been tantamount to a nation-wide protest, the survey has steadily built up such an extensive and powerful control machine that to-day our western wild life is confronted with the most serious crisis in its history. Realizing that the time for passive criticism had passed, the Society of Mammalogists, at the New York annual meeting of May, 1930, appointed a special committee on the problems of predatory mammal control, instructing this committee to attempt a critical investigation of actual conditions in the field, in which the committee personnel would cooperate as far as possible with special investigators from the survey.

The committee was able to conduct joint and independent investigations during 1930–31, which involved an itinerary of more than 12,000 miles in the Western United States Although the region to be covered is so vast, and the conditions so complex, that these studies can be considered as only a start upon the research which should be made into the life-histories of our western mammals and their relations to habitat, to vested interests and to the public in general, nevertheless enough was accomplished to confirm the society in its belief that undue value was being placed upon the claims of destruction done by mammals and that the control policies of the survey were placing an excessive toll upon all wild life in the attempt to control a few species

The committee presented its report at the annual meeting held in Philadelphia on May 14, 1931 After discussion, the report was adopted by the membership with only two dissenting votes It is no secret that some of the naturalists in the survey employ are much concerned over a policy with which they are not in accord and which has been continued and developed in response to powerful lobbies backed by special interests. From a small beginning, the control activities of the survey have been rapidly increased until they have assumed a dominating influence upon the conduct of the survey It is not difficult to understand how research and study into faunal relationship have been relegated to a post of minor importance, as the swelling appropriations for the slaughter of predators and rodents have demonstrated the success of this latter activity as a means of securing support from a Congress, ready to listen to any tale touching upon the interests of the live stock owner or agriculturist

As an instance of this doubt upon the part of some of the survey personnel that the policy of the survey toward predators should be defended, the remarks and conclusions of one of the survey's own investigators was read at the annual meeting The chief of the biological survey had shown his fair-mindedness in the joint investigations by exchanging field reports with the special committee of the mammalogists These remarks drew attention to the propaganda disseminated through survey channels and which was designed to paint certain species of mammals in the blackest tones and to create a desire for destruction wherever the public was lukewarm to these practices of the survey

During the discussion a member from Canada pointed out that a political boundary should not change the biological principles involved in this problem and remarks by others showed that no such tax upon wild life was either exacted by Canada or deemed necessary to protect her farmers and drovers

After summarizing the conclusions and opinions of the committee as based upon extensive data, the committee recommended to the society the following resolutions, which were passed, as stated above

(1) That the society strongly urges the Biological Survey that the use of poison as a control measure against predatory mammals be drastically curtailed, with the view of complete suspension of poisoning as soon as it is reasonably possible.

(2) That the society deplores the propaganda of the survey which is designed to unduly blacken the character of certain species of predatory mammals, giving only part of the facts and withholding the rest, and which propaganda is educating the public to advocate destruction of wild life.

(3) That the society asserts the claim of the great nature-loving public to a voice in the administration of our wild life resources, and challenges the right of a federal organization, such as the Biological Survey, to consider only the interests of a very small minority, the live stock interests.

It will be noted that the special committee has concerned itself chiefly with the problems raised by predatory mammal control. While these questions have been of paramount importance in the past, the employment of more deadly poisons against rodents, with a consequent more ruthless threat against all the animal life of the region where these operations are in force, has thrust forward the entire subject of the control policies of the survey as a topic of vital importance to every true conservationist

Dr. Jean M. Linsdale, in the *Condor* of May, 1931, has written an account of the use of thallium as a poison against the ground squirrel in California. This is a calm statement of findings and must impress the reader as an investigation conducted without bias or prejudice Dr Joseph Grinnell, in the same publication, in commenting upon Linsdale's data, figures that in four years, in California alone, not less than 50,000,000 animals other than ground squirrels have been killed through these operations This extermination has been carried on either under the direction or with the cooperation of the Bureau of Biological Survey and, during these years of thallium poisoning, spokesmen of the survey have been assuring the Society of Mammalogists that the taking of wild life was a regrettable duty and that, as far as it was humanely possible, every protection was being given to non-injurious species. The exposé by Linsdale shows how far the survey had been curtailing control activities at the time these pronouncements were made. As a fitting climax to the drama of thallium, the United States Department of Agriculture, in Bulletin No 238, April, 1931, written by Munch and Silver (the latter in the survey), discusses the use of thallium in rodent control and concludes with these significant words

> Thallium is a cumulative poison of high toxicity and is without taste, smell or other warning property It should not be recommended to the public as a rodent poison. Where the use of thallium is found necessary for the control of highly resistant species of rodents, it should be entrusted only to persons who understand its dangerous qualities and who will exercise appropriate care in handling it

When 602,728 pounds of grain poisoned by thallium are scattered in California in one year, 1929 (*vide* Linsdale), one wonders what constitutes "appropriate care"

Dr Witmer Stone, in an editorial in the *Auk*, July, 1931, page 477, expresses the attitude of all of the ornithologists who are informed on the matter, when he stresses the danger to bird life from such campaigns as the thallium drive of California He concludes: "If ever the 'appeal of the bird itself' needs our support it does so now."

The list of societies and opinions cited above might be greatly extended and organization after organization has gone on record as opposed to the present control policies of the Biological Survey This criticism is not the utterance of a few fanatics, as some of the survey champions would have one believe, but rather it is the most universal formal statement of opinion which has ever been expressed upon any activity of the survey.

The repercussions of the control policies of the survey are many and varied. The mouse plague of Kern County, California, 1926–7, has been attributed, with reason, to the poisoning of predatory mammals, a natural control over the numbers of mice. The fur trade is concerned over the fur-bearers needlessly killed by survey poison squads. A strong argument against extermination or near-extermination campaigns can be advanced on esthetic grounds for surely a young, faunally rich country like the United States does not wish the great open spaces swept clear of all wild life in order to make the West a sheep man's paradise. The American public should love its wild life and want it preserved in its original entirety as far as is reasonably possible.

But unless nature lovers throughout the length and breadth of the country assert themselves and demand a pause in this organized slaughter, the Biological Survey will continue to develop the technique of destruction and to expand along the lines which have proved to be such a bureaucratic success. The survey is subjected to great pressure by the forces working for specialized control, it is placed in an exceedingly awkward position. The conservationists must exert an even greater pressure against the control policies of the survey in order to accomplish any useful end. For awkward as is the plight of the survey, the lot of our wild life is even more precarious.

H. E. ANTHONY

AMERICAN MUSEUM OF
NATURAL HISTORY

FITTING THE CURVE OF THE DIMINISHING INCREMENT TO FEED CONSUMPTION-LIVE WEIGHT GROWTH CURVES

IN a recent paper,[1] Hendricks, Jull and Titus suggested a method of interpreting the results of feeding experiments by means of the curve of the diminishing increment. The senior author felt that the method might be more useful to workers in animal nutrition if the curve of the diminishing increment could be accurately fitted by some rapid method.

The most rapid method of determining the constants in the equation:

$$W = A - Be^{-kF} \qquad (1)$$

proposed up to the present time, is, perhaps, the method of arithlog plotting used by Brody.[2] However, it has been the experience of investigators at the U. S. Animal Husbandry Experiment Farm, Beltsville, Md., that, in many instances, it is difficult to judge accurately which value of the constant, A, makes the values of log (A – W) lie most nearly along a straight line, when plotted against the corresponding values of F as abscissae.

The writer has tried a method of approximating the values of the constants which appears to give much more accurate results than the method of arithlog plotting.

The differential form of equation (1) may be written

$$\frac{dW}{dF} = C - mW \qquad (2)$$

in which, C = kA, and, m = k. If finite increments are substituted for the infinitesimals of the Calculus, equation (2) becomes

$$\frac{\Delta W}{\Delta F} = C - mW \qquad (3)$$

in which the ratio, $\frac{\Delta W}{\Delta F}$, represents the gain in live weight, per unit feed eaten, over a short interval of time, and W represents the average live weight of the animal during that interval of time, calculated by taking one half of the sum of the live weights at the beginning and at the end of the interval.

The values of the ratio, $\frac{\Delta W}{\Delta F}$, for consecutive intervals of time, lie along a straight line, when plotted against the corresponding values of W as abscissae. A simple linear equation of the form, Y = aX + b, may be easily fitted to such a set of data by the method of least squares.

It is readily apparent that the slope of the fitted straight line is – m. The intercept of the line on the axis of ordinates is C, since when W = 0, $\frac{\Delta W}{\Delta F} = C$. The intercept of the line on the axis of abscissae gives the mature weight of the animal, since when $\frac{\Delta W}{\Delta F} = 0$, mW = C, and $W = \frac{C}{m}$, or A. The value of the constant, B, in equation (1) may be calculated by subtracting the initial weight of the animal from the mature weight, A.

The writer fitted equation (3) to data obtained from two lots of chickens which had been weighed each week up to the age of one year. The values of C, which Hendricks, Jull and Titus (*loc. cit.*) have interpreted to represent the true efficiency of the feed for growth, were found to be 0.343 and 0.355, respectively. The corresponding values, calculated after carefully "adjusting" the constants of the integrated equations by the method of least squares, are, respectively, 0 340 and 0 356. The error, due to the use of the rapid method of fitting the curves, was less than one per cent in each case, which is undoubtedly well within the limits of the experimental error involved

---

[1] Walter A. Hendricks, Morley A. Jull and Harry W. Titus, "A Possible Physiological Interpretation of the Law of the Diminishing Increment," SCIENCE, 73: 427–429, 1931.

[2] Samuel Brody, "Growth and Development with Special Reference to Domestic Animals. III Growth Rates, Their Evaluation and Significance," *Mo. Agr. Expt. Sta. Bull.* 97, 1927.

The chief source of inaccuracy in the rapid method of fitting the curves probably lies in using the gains in live weight, per unit feed eaten, over finite intervals of time as approximations to the values of the derivative, $\frac{dW}{dF}$ If the chickens used in the writer's study had been weighed at less frequent intervals, the rapid method probably would not have yielded quite such accurate results

The advantages of this method over the method of arithlog plotting are the elimination of the errors of judgment, which are inherent in the latter, and the fact that the value of the constant, C, which is of particular interest if the curve is used to interpret the results of a feeding experiment, can be determined directly

WALTER A HENDRICKS
BUREAU OF ANIMAL INDUSTRY,
U S DEPARTMENT OF AGRICULTURE

THE EFFECT OF THE APPLICATION OF A FIELD OF ATTRACTION TO A GAS

CONSIDER a gas of molecules, or electrons, in a shallow vessel having two of its plane walls parallel to each other The vessel is placed in a field of attraction with these walls at right angles to it Let us suppose that the conditions are such that a molecule on moving from one of these plane walls to the other has little chance of undergoing a collision with another molecule Hence when a molecule moves from one of the plane walls to the other against the field, it undergoes a decrease in velocity, while when it moves in the opposite direction its velocity undergoes an increase Hence the molecules impinge and rebound from one of the walls with a greater velocity than is the case at the other wall Now the velocity of rebound[1] is an index of the temperature of the gas close to the wall, and hence under these conditions there will be a continual transference of heat from one wall to the other But this is thermodynamically impossible It follows therefore that the molecules must undergo certain changes compensating for this effect of the field The occurrence of inelastic collisions of the molecules with the walls can not, it will be found, by themselves explain the effect If, however, we suppose that the molecules possess certain properties previously deduced in other ways,[2] this effect can be compensated for These properties are (a) A molecule, or electric charge, slows down when moving freely, and absorbs radiant energy in the process which is stored up as internal energy, (b) potential energy of attraction, or repulsion, may become internal energy, and *vice versa*, (c) internal energy may also be directly converted into radiation

We may now suppose that the internal energy accumulated by a molecule during its motion according to (a) and (b), is mainly converted into potential energy of repulsion according to (b), and this into kinetic energy, at the wall where the molecules arrive with a decrease in velocity This is to take place in such a manner that the average velocity of collision is reduced at one of the walls and increased at the other, so that the temperature is the same at both walls

If a different explanation of the difficulty is possible, I shall be glad to hear about it

R D KLEEMAN
SCHENECTADY, N Y

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE IOWA EYE-MOVEMENT CAMERA

MANY efficient cameras for photographing eye movements have been built since the inauguration of the corneal reflection method of eye photography by Dodge in 1901 The first cameras obtaining a continuous record of eye movement recorded only the horizontal movements of one eye Dearborn made an advance by recording the vertical movements of one eye on a horizontally moving film and the horizontal movements of the other eye on a vertically moving film. The camera herein described obtains simultaneous binocular records of both vertical and horizontal movements.

The light used to produce the corneal reflection for photographing is a direct current Bausch and Lomb automatic carbon arc This light, screened from the view of the reader, is placed at right angles to the eyes as is illustrated in Fig 1 The light is focussed by a large condensing lens on a diaphragm which allows only the center of the light from the positive carbon to pass on Between the light and the diaphragm is a chopping disc operated by a synchronous motor which interrupts the beam of light fifty times

---

[1] Apart from the increase caused by the attraction of the wall R. D Kleeman, *A Kinetic Theory of Gases and Liquids*, John Wiley & Sons, New York

[2] R D. Kleeman, *Phil Mag*, 7 493, 1929, *Nature*, 124: 728, 1929, SCIENCE, 70 478, 1929, 71. 340, 1930; 72 224, 1930, *Z anorg u algem. Chemie*, 196 284, 1931; *Z. Electro-chemie*, 37: 77, 1931; 37: 371, 1931

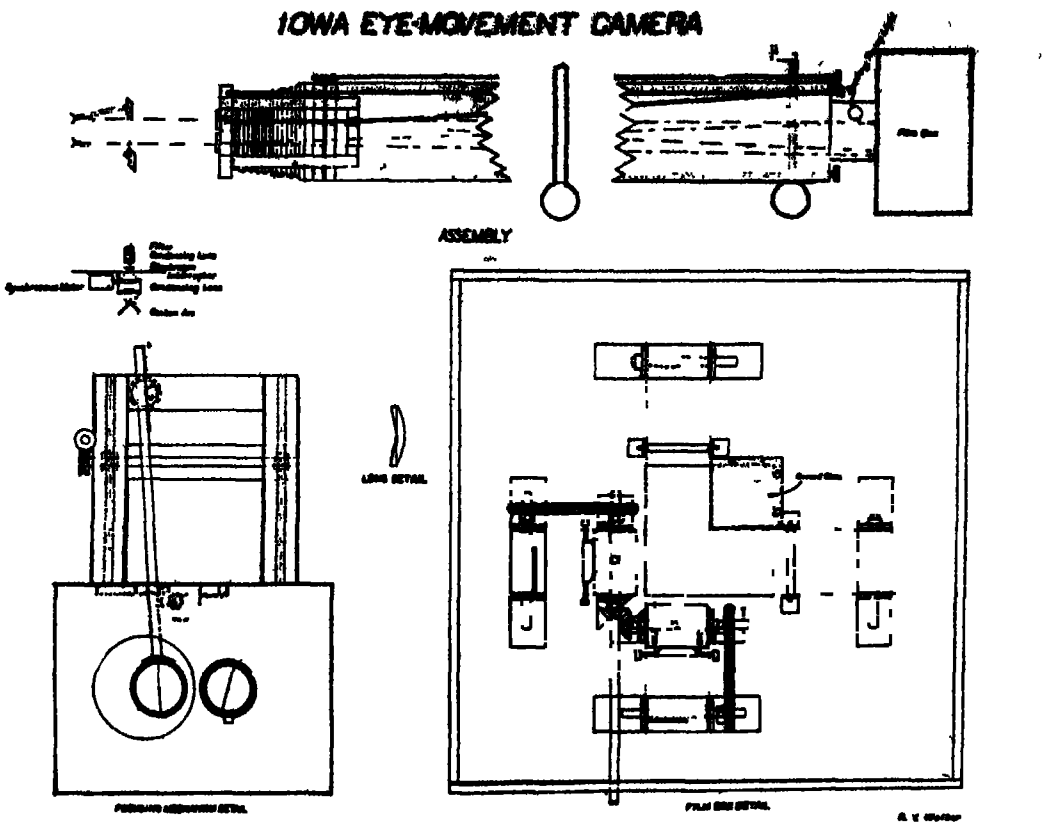


FIG 1

a second. The rays of light passing through the diaphragm are converged to a pencil beam by a second lens. The beam then passes through three cobalt blue filters before being reflected from two adjustable first surface mirrors to the eyes

Since this camera requires that the light reflected from each eye be recorded on two papers it was necessary to introduce a system of dividing the light beam from each cornea into two beams With the aid of the local branch of the Riggs Optical Co a pair of prisms were ground and mounted with Canada balsam base out on the plano surfaces of 2 5 diopter, 35 mm diameter crown glass lenses The prism strength of the left lens was 1 25 degrees, the right lens 1.5 degrees The difference in strength is necessary to permit the proper aligning of the reflected beams on the recording paper

The entire lens unit is mounted so that it may be adjusted in three dimensions Vertical and depth adjustments are made by racks and pinions on the lens mounting Horizontal adjustments are made by a worm at the rear which pivots the entire camera box The lens for the left eye is adjustable independently in the horizontal and vertical by means of racks and pinions as illustrated in the focussing mechanism detail (Fig. 1). All lens adjustments are made from the rear by means of telescoping rods.

The lenses, mounted approximately 20 cm from the eyes, focus the reflections from the corneas at the end of the camera box which is about 180 cm from the lens mounting This amplifies the movement nine times and permits the use of weak prisms, thereby insuring a sharp focus

Eastman No. 1 recording paper, 1⅜ inches wide, is moved synchronously in the vertical and horizontal directions by the mechanism illustrated in the film box detail (Fig 1) Spiked traction rollers insure positive movement of the paper between the guide rollers to the windup rollers A constant speed motor with a variable reduction gear is used for driving power A satisfactory rate of speed for most records is from 7 to 9 cm per second. Good records may be obtained at speeds up to 20 cm per second.

To facilitate focussing a piece of ground glass was mounted in one quarter of the aperture of the film box When a correct focus is obtained a slight shift of the camera in the horizontal and vertical places the beams of light in their proper place on the recording paper.

A mercury filled neon glow lamp is used as an auxiliary timing light or signal marker. The light, located in the rear of the camera, as indicated in the assembly (Fig. 1), passes through a slit dia-

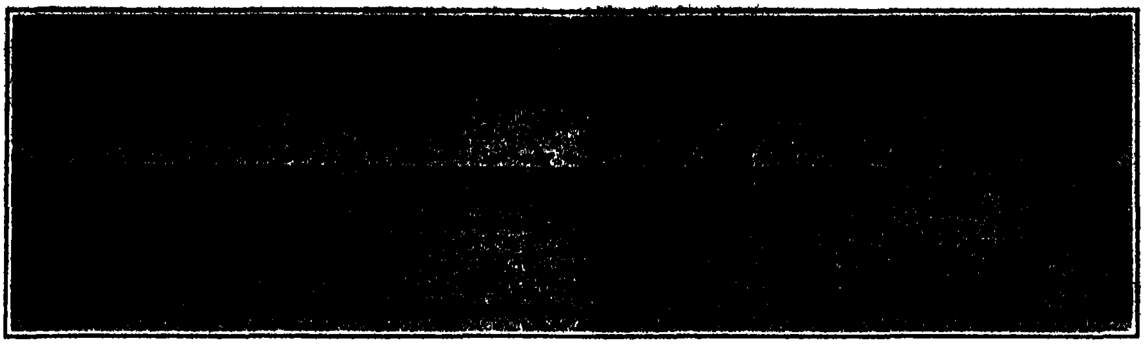


FIG. 2. Record A is the horizontal moving film which records the vertical movements of both eyes. The two upper lines in record B record the horizontal movements and the base line records the head movements on the vertical moving film. The strips of recording paper in this record are reduced from 1½ inches.

phragm and a condensing lens and is reflected from a mirror on the base of the inner side of the box to a focus across the intersection of the two recording papers. A perfect matching of the two records is thus made possible by matching the lines made on both records by a single light. This light may be flashed at regular intervals as an auxiliary timing device during reading movements, or it may be used to indicate the exact time of appearance of various other types of visual stimuli, or to indicate any other phenomena to be especially noted on the record.

The sample record in Fig. 2 shows the vertical and horizontal movements of the eyes in horizontal fixation movements and in the beginning of the reading of printed material. The first horizontal movement (reading from left to right) in record B is that of the eyes moving from left to right between the two fixation points placed above the first and last letter of the first line of the printed material. 78 mm movement on the record represents 1 degree of angular eye movement. The movement is indicated in record A by the spreading of spots due to the beams of light moving in the opposite direction to that of the recording paper. The next curve in record A indicates a marked upward twitch of the eyes of 1 second duration. The next movement indicated in both records is the return sweep from right to left preparatory to the beginning of reading. Since this movement is made in the same direction and faster than the movement of the recording paper it is indicated on record A by an overlapping of the lines of spots. The succeeding part of the record is that of a long fixation at the beginning of the line and the saccadic movements and fixation pauses during reading.

The base line of head movements in record B is obtained by recording the reflection from a steel ball mounted on a spectacle frame worn by the reader. The two adjacent marks on both records are produced by the signal marker mentioned above.

There are two methods of obtaining time measurements on this record. (1) The duration of any single movement may be measured by counting the number of small spots contained in that movement, each spot being equal to 02 second. These small spots are produced by the interruption of the light beam by the chopping disc described above. (2) Gross measurements may be made by measuring the length of record made by any movement and converting them into time measurements according to the speed of the recording paper. The exact speed of the paper may be continually checked by measuring the distance between the dashes in the record which occur twice a second. These dashes are produced by removing two of the interrupters in the chopping disc. This disc carries 25 interrupters (23 with the 2 omitted) and revolves twice a second, hence the dashes appear twice a second and are .05 second long.

In studying binocular coordination it is necessary to know the position on the record of one eye relative to the other. The dashes in the record, since they are produced by an interruption of the light previous to any division of the beam, make the relative position of the two eyes clear throughout the record.

The large cost of many of the satisfactory eye-movement cameras now in operation has heretofore prohibited their use in several laboratories. The cost of the materials used in the construction of this camera amounted to less than one hundred and fifty dollars. The use of recording paper costing about one cent a foot is an additional saving in expense as well as an aid in reading. The entire mechanism was built in a good laboratory shop by graduate students who were not skilled mechanics.

In summary the advantages of the Iowa Eye-Movement camera may be stated as follows: (1) Simultaneous recording of binocular horizontal and vertical movements, (2) the production of positive record of sufficient magnification for easy reading, (3) readily adaptable to various types of eye-movement problems other than reading, (4) low cost of construction and operation.

The problems for which this camera is now being used are (1) The study of binocular coordination in convergence and divergence movements of alternate fixation on near and far points of light, (2) the analysis of eye movements of good and poor readers who have the same intelligence rating, (3) the determination of the attention value of different types of advertisements and of different items in a single advertisement, (4) analysis of changes that take place in eye-movement habits of poor readers who have been subjected to intensive remedial training; (5) binocular coordination of stutterers *versus* that of normal speakers, and (6) disintegration of eye-movements during stuttering spasms

Herbert H Jasper
Robert Y Walker
University of Iowa

SPECIAL ARTICLES

THE GREAT GLACIAL CYCLE

It is fairly well known that the present Ice Age, or the cycle of ice ages in an interglacial period of which we now live, was preceded by other ages or cycles of ages, leading as far back as we can see in geological history[1] Some of these have been limited in extent, both of time and area, but others have involved large areas of the earth for millions of years If we consider the greater cycles that are most recent and most certainly identified, and compare them with the absolute dates which have been obtained from radioactive changes,[2] we find that they occurred at intervals of some 200,000,000 years Thus we may make the following comparisons, giving the periods in millions of years I have used a unit of 210 millions, as it seems to fit a little better than the even 200, especially at the Cobalt glaciation, but the uncertainty of the data makes the difference trivial

210 *Permocarboniferous Glaciation*

204 Joachimstal pitchblende, supposed Permocarboniferous
239 North Carolina uraninite, supposed late Carboniferous

A very long and widely distributed glacial period, mainly in the southern hemisphere and lasting through the later Carboniferous and much of the Permian, with its climax at the beginning of the Permian

420 *Late Ordovician Glaciation*

374 Branchville, Ct, uraninite, Silurian or Devonian.
443 Lake Superior coracite, early or middle Ordovician

This cycle is not so well defined, but seems to cover larger area in Quebec, and is also represented in Europe

630 *Early Cambrian or late Precambrian Glaciation*

573 Katanga pitchblende, late Precambrian
587 Ceylon thorianite, late Precambrian
673 Morogoro, Tanganyika, late Precambrian

This shows a very large area of glaciation in the world, but much of it is of uncertain date and may belong to the following period, back from this time fossil dating is no longer possible, and it becomes difficult to join up dated igneous rocks with the corresponding glacial deposits, except where, as at Cobalt, they are directly associated

840 *Keweenawan*

No dated radioactive rocks, Reeds gives this as the date for the Keweenawan, which shows doubtful glacial remains about Lake Superior

1050 *Cobalt (Huronian)*

987 Olary, S Australia, Animikian
1024 Ontario uraninite, Animikian
1056 Arendal, Norway, cleveite, Cobaltian
1087 Llano Co, Texas, uraninite and Douglas Co, Col Samarskite, Cobaltian

This is evidently a major glaciation at least in Canada, where the Cobaltian radioactive dated rocks and glacial remains are directly associated Coleman discusses the Animikian as Precambrian and the Cobaltian as Huronian, but the radioactive dating suggests a single cycle Extensive glacial traces elsewhere may belong to this cycle

1260 *Algoman*

No dated glacial remains.

1470 *Timiskamian*

1465 Keystone, South Dakota, uraninite, Timiskaming.

Extensive glacial traces in Canada, doubtful elsewhere.

1680 *Keewatin*

Doré conglomerate of Canada a possible representative of this or an earlier cycle No radioactive dating, so far as I know

Plaskett[3] has just estimated that it takes the solar system 230,000,000 years to make the great circle around the system of the Milky Way The rough agreement suggests a connection It is well known that at present the dense center of the Milky Way is obscured behind a cloud of opaque matter. It may be suggested that this center radiates a small but substantial amount of heat, sufficient to raise the temperature of the earth a few degrees. If this is the case, during the periods when the earth does not lie behind the obscuring cloud, it will be a few degrees warmer, and when the cloud passes in front, the temperature will drop a corresponding small amount. Such a small difference in temperature may well make the difference between a stretch of time when glacial periods are frequent and wide-spread, and one when they are rare and mainly limited to mountain areas.

---

[1] A P Coleman, "Ice Ages, Recent and Ancient," New York, Macmillan, 1926

[2] Holmes and Lawson: *Am. Jour Sci.* (5) 13: 327, 1927, brought up to date and diagrammatically presented by C A Reeds, *Nat Hist* 31: 129, 1931.

[3] *Proc. Am. Phil. Soc.*, 69: 417, 1931.

As the obscuring cloud is nearer to the center of the Milky Way than ourselves, the obvious assumption is that it is revolving about the center more rapidly than ourselves (obviously in the same direction). We can calculate what its period would have to be, to occult the center every 210 million years, and it works out at 110 million years. Assuming that most of the mass of the Milky Way is concentrated at its center (Plaskett suggests 80 per cent.), this would make the radius of its orbit of the order of 5,000 light-years.

If this is the case we have gone about the center of the Milky Way some eight times, and the obscuring mass about 17 times, since the oldest visible rocks were laid down, some 1,850 million years ago.

This scheme is presented as a suggestive hypothesis, rather than a full-fledged theory. Its chief weaknesses are two: one due to the uncertain dating of the geological deposits, especially as glacial deposits and datable radioactive ones (igneous) are rarely found in close association, the other, which Dr. Boothroyd would emphasize, that the amount of radiation possible from the center of the galaxy would not be able to raise the temperature of the solar system even the few degrees necessary. A systematic error in the radioactive datings might change the figures involved somewhat, but could hardly be large enough to interfere seriously.

WM. T. M. FORBES

CORNELL UNIVERSITY

EGGS OF FRESH-WATER FISHES SUITABLE FOR PHYSIOLOGICAL RESEARCH[1]

Fundulus heteroclitus, a marine Poeciliidae commonly called the killifish, or marine minnow, has been used for many years as the standard fish for various types of physiological research. Their eggs are especially well adapted for experimental studies due to the fact that they can be easily fertilized in the laboratory and their embryos can be observed during development through the transparent shell membrane.

It is not always possible or desirable, however, for the investigator to conduct his research at a marine biological station but since several of the fresh-water laboratories are now equipped for fundamental physiological research as well as for ecology, life-history and taxonomic studies, it may be of interest to call attention to a few species of fresh-water fishes, the eggs of which have been found to be very satisfactory for research on the beat of the embryonic heart. By the use of these eggs it is often possible for the inland investigator to conduct his research in or near his own laboratory.

The log-perch (*Percina caprodes*)[2] is one of the larger and more abundant of the darters belonging to the family Percidae. It occurs in all the Great Lakes, in Lake Champlain, in the St. Lawrence and the various tributaries of this system and ranges south to Virginia, Alabama and throughout the Ohio basin, westward to Kansas, and southwestward to Texas. An excellent colored plate and description of this species is contained in Forbes and Richardson's "Fishes of Illinois." The plate is opposite page 282.

The adults are found in schools of several hundred at spawning time. The spawning beds are found along the shallow windswept shores of lakes, usually where sand is abundant. When the water is quiet the schools move to the very edge of the lake and spawn in a few inches of water. Spawning takes place during the day time on quiet days. The males remain in a group while the females rest on the sand at the edge of the spawning area. At intervals the individual females move toward the group of males, one of which starts spawning with her, during the progress of which the eggs and sperm are emitted while the tails vibrate in such a way as to dig a pit in the sand and cover many of the eggs. Reighard[3] has described the spawning and method of sex recognition of this species in excellent detail. Spawning takes place from as early as June 15th and may continue as late as July 20th at the University of Michigan Biological Station on Douglas Lake in Northern Michigan.

During the spawning season log-perch are easily collected with a twenty-five or thirty foot minnow net. The fish can be stripped immediately and the eggs fertilized in finger bowls or syracuse watch-glasses or fishes may be kept in an aquarium with the water at a cool temperature and stripped when desired. A 70 to 80 per cent. fertilization is usually secured if the eggs are fertilized by the dry method. The eggs are collected in the dry watch-glasses and the concentrated sperm poured over the eggs and a minute or two allowed to elapse before the addition of water. The watch-glasses are then kept in a covered crystallization dish filled with water to a depth just greater than the height of the syracuse watch-glasses which contain the eggs. Water changes can be made in the main dish leaving the eggs undisturbed. When examination is necessary the watch-glasses may be lifted out of the water and placed on the stand of the microscope.

---

[1] Contributions from the University of Michigan Biological Station, North Dakota State College, and The College of the City of Detroit.

[2] For a discussion of the taxonomy of this species see Hubbs and Brown, *Trans. Roy. Can. Inst.*, 17: 1–56, 1929.

[3] Reighard, Papers of Mich. Acad. Sci., p. 104–105, 1913.

The eggs are about a millimeter and a half in diameter and are perfectly clear and transparent. Cleavage and development is rapid. The first cleavage furrow appears in about an hour at the temperature of the water during spawning. The pulsating heart can be observed on the second day and the circulation is very distinct on the third day. At a general temperature of about 22° C. the eggs hatch on the seventh day. For two or three days after hatching the larvae remain inactive and lie on their sides on the bottom of the dish. In this position the heart action and the course of circulation can be easily studied. Pigment cells are practically wanting at this stage and the blood corpuscles can be seen passing through the finest of the capillaries.

The abundant straw-colored minnow (*Notropis deliciosus*) is found from Michigan, Ohio, Ontario, and New York to Tennessee, westward to the Dakotas, and southwestward to Kansas and Texas. An excellent colored plate of this species is contained in Forbes and Richardson's "Fishes of Illinois," opposite page 137. For a key for the identification of the Great Lakes minnows and a discussion of nomenclature see Hubbs' "List of the Fishes of the Great Lakes, etc."[4]

The straw-colored minnows are found in spawning condition along sandy shores and are usually taken best at night. Little is known of their natural spawning. Working with a seine at night they can be taken in numbers sufficient for experimentation. The fishes can be stripped and the eggs fertilized in the same manner as *Percina*. The spawning season extends a little later than *Percina,* lasting until August 1st at Douglas Lake. The eggs are about a millimeter in diameter and are transparent. Development is very rapid. The first cleavage furrow appears within an hour after fertilization, followed by the second about fifteen minutes later. The eggs hatch about 72 hours after fertilization at temperature 22°–24° C.

The eggs of the common shiner, *Notropis cornutus,* are also excellent material for research. The development is not so rapid, however, as in the straw-colored minnow. They are best taken at night with seine or fine-meshed fyke.

Eggs of the common yellow perch (*Perca flavescens*) are quite satisfactory but the females can not be stripped with any degree of success and the eggs must be secured after they have been naturally spawned and hence the exact time of fertilization can not readily be ascertained. These eggs can frequently be secured from fish hatcheries in April and May in Michigan, and thus are available at an early date.

Reighard[5] worked with a related species wall-eyed pike (*S. vitreum*) which should be satisfactory for physiological purposes.

This list is very incomplete, and no doubt more study will add other species producing suitable eggs for work throughout the spring and summer months.

FLOYD J. BRINLEY
NORTH DAKOTA STATE COLLEGE
CHARLES W. CREASER
COLLEGE OF THE CITY OF DETROIT

BOOKS RECEIVED

ALLEN, FRANK. *The Universe from Crystal Spheres to Relativity.* Pp. xiv + 145. 31 figures. Harcourt, Brace. $2.00.

BABOR, JOSEPH A., WILLIAM L. ESTABROOKE and ALEXANDER LEHRMAN. *Elements of General Chemistry.* Pp. x + 601. 135 figures. Thomas Y. Crowell. $3.75.

BOLDYREFF, TATIANA W. *By Word of Mouth.* Pp. 144. Badger.

DAVIS, MICHAEL M. *Paying Your Sickness Bills.* Pp. xi + 276. University of Chicago Press. $2.50.

FISCHER, F. and H. LICHTE. *Tonfilm Aufnahme und Wiedergabe nach dem Klangfilm-Verfahren.* Pp. xi + 455. 378 illustrations. S. Hirzel, Leipzig.

FLETCHER, HARVEY. *Physical Characteristics of Speech and Music.* Pp. 25. 21 figures. Bell Telephone Laboratories, New York.

HAN-SENG, CHEN. *Notes on Migration of Nan Min to the Northeast.* Pp. 31. China Council of the Institute of Pacific Relations, Shanghai.

MANLEY, R. M. *Synthetic Philosophy.* Pp. 66. Author.

NOBLE, G. KINGSLEY. *The Biology of the Amphibia.* Pp. xiii + 577. 174 figures. McGraw-Hill. $5.00.

PARTINGTON, J. R. *A Text-Book of Inorganic Chemistry.* Third edition. Pp. viii + 1083. 390 figures. Macmillan. $4.75.

PLANCK, MAX. *The Universe in the Light of Modern Physics.* Translated by W. H. Johnston. Pp. 114. Norton. $2.00.

RUSSELL, BERTRAND. *The Scientific Outlook.* Pp. x + 277. Norton. $3.00.

TEXAS AGRICULTURAL EXPERIMENT STATION. *Forty-third Annual Report, 1930.* Pp. 167. Agricultural and Mechanical College of Texas.

TÔHOKU IMPERIAL UNIVERSITY. *The Science Reports.* First Series: *Mathematics, Physics, Chemistry.* Volume XX, No. 3. Pp. 323–488. Illustrated. Maruzen Company, Tokyo.

WEIDLEIN, EDWARD R. and WILLIAM A. HAMOR. *Science in Action.* Pp. xiii + 310. 32 illustrations. McGraw-Hill. $3.00.

---

[4] Hubbs, Univ. of Mich. Museum, Miscellaneous Publications No. 15, 1926.

[5] Reighard, "Development of the Wall-eyed Pike (*S. vitreum*)," Mich. Fish Comm. *Bull.*, 1: 66, pl. 1–18, 1890, Lansing, Mich.

SCIENCE

Vol. 74 FRIDAY, SEPTEMBER 25, 1931 No. 1917

British Association for the Advancement of Science

The Scientific World Picture of To-day: GENERAL THE RIGHT HONORABLE J. C. SMUTS ... 297

Scientific Events

The National Metal Congress, Clinical Congress of the Connecticut State Medical Society, The British Industrial Health Research Board ... 305

Scientific Notes and News ... 307

Discussion

Expulsion of Gas and Liquids from Tree Trunks: DR. FERDINAND W. HAASIS. *Catfish Feeding on the Eggs of the Horseshoe Crab, Limulus Polyphemus*: LOUISE MERRIMON PERRY. *The Lack of Correlation between Anemia and the Pellagra-like Symptoms in Rats*: DR. NELLIE HALLIDAY ... 311

Scientific Apparatus and Laboratory Methods

A Light Filter for Microscopes: PROFESSOR C. E. THARALDSEN ... 313

Special Articles

Control of Powdery Mildew and Red Spider on Greenhouse Cucumbers: L. J. ALEXANDER and DR. H. C. YOUNG. *Phagocytosis of Brucella, an Index of Immunity to Undulant Fever in Man*: DR. I. FOREST HUDDLESON and HOWARD W. JOHNSON. *The Effect of Temperature on the Number of Scales in Trout*: C. McC. MOTTLEY ... 314

Science News ... 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE SCIENTIFIC WORLD-PICTURE OF TO-DAY[1]

By General the Right Honorable J. C. SMUTS

AFTER what I said at the opening this afternoon it is unnecessary for me to emphasize further the significance of this Centenary Meeting of our association. It is a milestone which enables us to look back upon a hundred years of scientific progress, such as has no parallel in history. It brings us to a point in the advance from which we can confidently look forward to fundamental solutions and discoveries in the near future, which may transform the entire field of science. In this second and greater renaissance of the human spirit this association and its members have borne a foremost part, to which it would be impossible for me to do justice to-night. I shall therefore not attempt to review the achievements of this century of science, but shall content myself with the simpler undertaking of giving a generalized composite impression of the present situation in science. The honor of presiding over this historic meeting, which was not of my seeking, and for which I was chosen on grounds other than my personal merits, is indeed an almost overwhelming one, and I confidently appeal for your indulgence in the difficult task which awaits me to-night.

I am going to ask the question to-night: What sort of world-picture is science leading to? Is science tending towards a definite scientific outlook on the universe, and how does it differ from the traditional outlook of common sense?

The question is not without its interest. For our world-view is closely connected with our sense of ultimate values, our reading of the riddle of the universe, and of the meaning of life and of human destiny. Our scientific world-picture will draw its material from all the sciences. Among these, physical science will—in view of its revolutionary discoveries in recent years—be a most important source. But no less important will be the contribution of the biological sciences with their clear revelation of organic structure and function as well as of organic evolution. And last, not least, the social and mental sciences will not only supply valuable material, but especially methods of interpretation, insights into meanings and values, without which the perspectives of our world-picture would be hopelessly wrong

---

[1] Address of the president of the British Association for the Advancement of Science, London, September 23, 1931.

Can we from some reunion or symposium of these sciences obtain a world-picture or synoptic view of the universe, based on observation and calculation, which are the instruments of science, but reaching beyond the particular phenomena which are its immediate field to a conception of the universe as a whole?

That was how science began—in the attempt to find some simple substances or elements to which the complex world of phenomena could in the last analysis be reduced The century over which we now look back, with its wonderful advance in the methods and technique of exact observation, has been a period of specialization or decentralization Have we now reached a point where science can again become universal in its ultimate outlook? Has a scientific world-picture become possible?

Of course there can be no final picture at any one stage of culture The canvas is as large as the universe, and the moving finger of humanity itself will fill it in from age to age All the advances of knowledge, all the new insights gained from those advances will from time to time be blended into that picture To the deeper insight of every era of our human advance there has been some such world-picture, however vague and faulty It has been continually changing with the changing knowledge and beliefs of man Thus, there was the world of magic and animism, which was followed by that of the early nature gods There was the geocentric world which still survives in the world of common sense There is the machine or mechanistic world-view dominant since the time of Galileo and Newton, and now, since the coming of Einstein, being replaced by the mathematician's conception of the universe as a symbolic structure of which no mechanical model is possible All these world-views have in turn obtained currency according as some well-defined aspect of our advancing knowledge has from time to time been dominant My object to-night is to focus attention on the sort of world-picture which results from the advances of physical, biological and mental science during the period covered roughly by the activities of our association

Science arose from our ordinary experience and common-sense outlook The world of common sense is a world of matter, of material stuff, of real separate things and their properties which act on each other and cause changes in each other To the various things observable by the senses were added the imperceptible things—space and time, invisible forces, life and the soul. Even these were not enough, and the supernatural was added to the natural world. The original inventory was continually being enlarged, and thus a complex empirical world-view arose, full of latent contradictions, but with a solid basis of actual experience and facts behind it.

Speaking generally, we may say that this is substantially still the common-sense view of the world and the background of our common practical beliefs. How has science dealt with this common-sense empirical world-view? The fundamental procedure of science has been to rely on sense observation and experiment, and to base theory on fact Thus the vast body of exact science arose, and all entities were discarded which were either inconsistent with observed facts or unnecessary for their strict interpretation The atomic view of matter was established Ether was given a status in the physical order, which is now again being questioned in the light of the conception of space-time New entities like energy emerged, old entities like forces disappeared, the principle of the uniformity of nature was established, the laws of motion, of conservation and of electromagnetism were formulated, and on their basis a closed mechanistic order of nature was constructed, forming a rigid deterministic scheme Into this scheme it has been difficult, if not impossible, to fit entities like life and mind, and the scientific attitude has on the whole been to put them to a suspense account and to await developments As to the supernatural, science is or has been agnostic, if not frankly sceptical Such, in very general terms, was the scientific outlook of the nineteenth century, which has not yet completely passed away It will be noticed that much of the fundamental outlook of common sense has thus survived, though clarified and purified by a closer accord with facts This scientific view retained unimpaired and indeed stressed with a new emphasis the things of common sense, matter, time and space, as well as all material or physical entities which are capable of observation or experimental verification Nineteenth-century science is, in fact, a system of purified, glorified common sense Its deterministic theory certainly gave a shock to the common man's instinctive belief in free will, in most other respects it conformed to the outlook of common sense It is true that its practical inventions have produced the most astounding changes in our material civilization, but neither in its methods nor in its world-outlook was there anything really revolutionary

But underneath this placid surface, the seeds of the future were germinating. With the coming of the twentieth century, fundamental changes began to set in. The new point of departure was reached when physical science ceased to confine its attention to the things that are observed It dug down to a deeper level, and below the things that appear to the senses, it found, or invented, at the base of the world, so-called scientific entities, not capable of direct observation, but which are necessary to account for the facts of observation. Thus, below molecules and atoms still more ultimate entities appeared, radiations, electrons and protons emerged as elements which underlie and form our world of matter Matter itself, the time-honored mother of all, practically disappeared into electrical energy

> The cloud capp'd towers, the gorgeous palaces,
> The solemn temples, the great globe itself

yea, all the material forms of earth and sky and sea were dissolved and spirited away into the blue of energy Outstanding among the men who brought about this transformation are two of my predecessors in this chair Sir J J Thomson and Lord Rutherford Like Prospero, like Shakespeare himself, they must be reckoned among the magicians

Great as was this advance, it does not stand alone Away in the last century, Clerk Maxwell, following up Faraday's theories and experiments, had formulated his celebrated equations of the electromagnetic field, which applied to light no less than to electromagnetism, and the exploration of this fruitful subject led Minkowski to the amazing discovery in 1908 that time and space were not separate things, but constituent elements in the deeper synthesis of space-time Thus time is as much of the essence of things as space, it enters from the first into their existence as an integral element Time is not something extra and superadded to things in their behavior, but is integral and basic to their constitution The stuff of the world is thus envisaged as events instead of material things

This physical concept or insight of space-time is our first revolutionary innovation, our first complete break with the old world of common sense Already it has proved an instrument of amazing power in the newer physics In the hands of an Einstein it has led beyond Euclid and Newton, to the recasting of the law and the concept of gravitation, and to the new relativity conception of the basic structure of the world The transformation of the concept of space, owing to the injection into it of time, has destroyed the old passive homogeneous notion of space and has substituted a flexible, variable continuum, the curvatures and unevennesses of which constitute to our senses what we call a material world The new concept has made it possible to construe matter, mass and energy as but definite measurable conditions of curvature in the structure of space-time Assuming that electromagnetism will eventually follow the fate of gravitation, we may say that space-time will then appear as the scientific concept for the only physical reality in the universe, and that matter and energy in all their forms will have disappeared as independent entities and will have become mere configurations of this space-time This will probably involve an amplified concept of space-time Einstein has recently indicated that for further advance a modification in our space-time concept will become necessary, and that the additional element of direction will have to be incorporated into it Whatever change may become necessary in our space-time concept, there can be no doubt about the immense possibilities it has opened up.

I pass on to an even more revolutionary recent advance of physics The space-time world, however novel, however shattering to common sense, is not in conflict with reason Indeed, the space-time world is largely a discovery of the mathematical reason and is an entirely rational world It is a world where reason, as it were, dissolves the refractoriness of the old material substance and smooths it out into forms of space-time Science, which began with empirical brute facts, seems to be heading for the reign of pure reason But wait a bit, another fundamental discovery of our age has apparently taken us beyond the bounds of rationality, and is thus even more revolutionary than that of space-time I refer to the quantum theory, Max Planck's discovery at the end of the nineteenth century, according to which energy is granular, consisting of discrete grains or quanta The world in space-time is a continuum, the quantum action is a negation of continuity Thus arises the contradiction, not only of common sense, but apparently also of reason itself The quantum appears to behave like a particle, but a particle out of space or time As Sir Arthur Eddington graphically puts it, a quantum of light is large enough to fill the lens of a hundred-inch telescope, but it is also small enough to enter an atom It may spread like a circular wave through the universe, but when it hits its mark, this cosmic wave instantaneously contracts to a point where it strikes with its full and undivided force Space-time, therefore, does not seem to exist for the quantum, at least not in its lower multiples Nay, more the very hitting of its mark presents another strange puzzle, which seems to defy the principles of causation and of the uniformity of nature, and to take us into the realm of chance and probability The significant thing is that this strange quantum character of the universe is not the result of theory but is an experimental fact well attested from several departments of physics In spite of the strange Puck-like behavior of the quantum, we should not lightly conclude, with some prominent physicists, that the universe has a skeleton in its cupboard in the shape of an irrational or chaotic factor. Our macroscopic concepts may not fit this ultra-microscopic world of the quantum And our best hopes for the future are founded on the working out of a new system of concepts and laws suited to this new world that has swum into the ken of science. The rapid development of wave mechanics in the last four years seems to have brought us within sight of this ideal, and we are beginning to discern a new kind of order in the microscopic elements of the world, very different from any type of law hitherto imagined in science, but none the less a rational order capable of mathematical formulation

We may summarize these remarks by saying that the vastly improved technique of research has led to physical discoveries in recent years which have at last completely shattered the traditional common-sense view of the material world A new space-time world has emerged which is essentially immaterial, and in which the old-time matter, and even the scientific mass, gravitation and energy stand for no independent entities, but can best be construed as configurations of space-time And the discovery of the quantic properties of this world points to still more radical transformations which loom on the horizon of science. The complete recasting of many of our categories of experience and thought may ultimately be involved.

From the brilliant discoveries of physical science we pass on to the advances in biological science which, although far less revolutionary, have been scarcely less important for our world-outlook The most important biological discovery of the last century was the great fact of organic evolution, and for this fact the space-time concept has at last come to provide the necessary physical basis It is unnecessary for my purpose to canvass the claims and discuss the views represented by the great names of Lamarck, Darwin and Mendel, beyond saying that they represent a progressive advance in biological discovery, the end of which has by no means been reached yet. Whatever doubts and differences of opinion there may be about the methods, the mechanism or the causes, there is no doubt about the reality of organic evolution, which is one of the most firmly established results in the whole range of science Paleontology, embryology, comparative anatomy, taxonomy and geographical distribution all combine to give the most convincing testimony that throughout the history of this earth life has advanced genetically from at most a few simple primitive forms to ever more numerous and highly specialized forms Under the double influence of the internal genetic and the external environmental factors life has subtly adapted itself to the ever-changing situations on this planet In the process of this evolution not only new structures and organs, but also new functions and powers have successively appeared, culminating in the master key of mind and in the crowning achievement of human personality. To have hammered the great truth of organic evolution into the consciousness of mankind is the undying achievement of Charles Darwin, by the side of which his discovery of natural selection as the method of evolution is of secondary importance

The acceptance of the theory of evolution has brought about a far-reaching change in our outlook on the universe and our sense of values The story of creation, so intimately associated with the groundwork of most religions, has thus come to be rewritten. The unity and interconnections of life in all its manifold forms have been clearly recognized And man himself has had to come down from his privileged position among the angels and take his proper place in the universe as part of the order of nature Thus Darwin completes the revolution begun by Copernicus

Space-time finds its natural completion in organic evolution For in organic evolution the time aspect of the world finds its most authentic expression The world truly becomes process, where nothing ever remains the same or is a duplicate of anything else, but a growing, gathering, creative stream of unique events rolls forever forward

But while we recognize this intimate connection between the conceptions of space-time and organic evolution, we should be careful not to identify the time of evolution with that of space-time There is a very real difference between them Biological time has direction, passes from the past to the future, and is therefore historical It corresponds to the "before" and "after" of our conscious experience. Physical time as an aspect of space-time is neutral as regards direction It is space-like, and may be plus or minus, but does not distinguish between past or future. It may move in either direction, backwards or forwards, while biological time, like the time of experience, knows only a forward flow. Hence cosmic evolution, as we see it in astronomy and physics, is mostly in an opposite direction to that of organic evolution. While biological time on the whole shows a forward movement towards ever higher organization and rising qualities throughout the geological ages, the process of the physical world is mostly in the opposite direction[2]—towards disorganization, disintegration of more complex structures and dissipation of energy. The second law of thermodynamics thus marks the direction of physical time While the smaller world of life seems on the whole to be on the up-grade, the larger physical universe is on the down-grade. One may say that in the universe we witness a majority movement downward, and a minority movement upward The energy which is being dissipated by the decay of physical structure is being partly taken up and organized into life structures—at any rate on this planet. Life and mind thus appear as products of the cosmic decline, and arise like the phoenix from the ashes of a universe radiating itself away. In them nature seems to have discovered a secret which enables her to irradiate with imperishable glory the decay to which she seems physically doomed.

---

[2] No doubt there are exceptions to this broad generalization. In astronomy stars and solar systems and galaxies are probably still being formed, while in physics syntheses of elements may possibly still be going on. In the same way we find in organic evolution minor phases of regression, degeneration and parasitism.

Another striking point arises here. Organic evolution describes the specific process of what we call life, perhaps the most mysterious phenomenon of this mysterious universe. When we ask what is the nature of life we are curiously reminded of the behavior of the quantum referred to. I do not for a moment wish to say that the quantum is the physical basis of life, but I do say that in the quantum the physical world offers an analogy to life which is at least suggestive. The quantum follows the all-or-nothing law and behaves as an indivisible whole; so does life. A part of a quantum is not something less than a quantum, it is nothing or sheer nonentity; the same holds true of life. The quantum is perhaps most easily symbolized as a wave or combination of waves, which can only exist as a complete periodicity, and whose very concept negatives its existence as partial or truncated. In other words, it is a specific configuration and can only exist as such; the same holds true of life. The quantum does not fall completely within the deterministic causal scheme; the same seems true of life. Significant, also, is the fact that quantum phenomena underlie secondary qualities such as color and the like, which the older science in its mechanistic scheme ignored, but which are specially associated with life and consciousness. Apparently the quantum does not fall completely within the causal deterministic scheme; the same is true of life. Life is not an entity, physical or other. It is a type of organization, it is a specific principle of central or self-organization. If that organization is interfered with we are left, not with bits of life, but with death. The nature of living things is determined, not by the nature of their parts, but by the nature or principle of their organization. In short, the quantum and life seem to have this in common, that they both behave as wholes.

I have before now endeavored to explore the concept of life in the light of the more general concept of the whole. A whole is not a sum of parts, or constituted by its parts. Its nature lies in its constitution more than in its parts. The part in the whole is no longer the same as the part in isolation. The interesting point is that while this concept of the whole applies to life, it is according to the recent physics no less applicable to the ultimate physical units. Thus the electron within an atom is no longer a distinct electron. There may be separate electrons, but when they cease to be separate they also cease to be. The eight electrons which circulate in an oxygen atom are merged in a whole in such a way that they have lost their separate identity, and this loss of individuality has to be taken into account in calculations as to the physical behavior of the atom. The physicist, in fact, finds himself unable to look upon the entity which is one eighth of eight electrons as the same thing as a single electron. At the very foundation, therefore, of physics, the principle or category of the whole applies no less than in the advanced structure of life, although not in the same degree. In the ultimate analysis of the world, both at the physical and the biological level, the part or unit element somehow becomes shadowy and incoherent, and the very basis of mechanism is undermined. It would almost seem as if the world in its very essence is holistic, and as if the notion of individual parts is a practical makeshift without final validity in the nature of things.

The general trend of the recent advances in physics has thus been towards the recognition of the fundamental organic character of the material world. Physics and biology are beginning to look not so utterly unlike each other. Hitherto the great gulf in nature has lain between the material and the vital, between inorganic matter and life. This gulf is now in process of being bridged. The new physics, in dissolving the material world of common sense and discovering the finer structure of physical nature, has at the same time disclosed certain fundamental features which it has in common with the organic world. Stuff-like entities have disappeared and have been replaced by space-time configurations, whose very nature depends on their principle of organization. And this principle, which I have ventured to call holism, appears to be at bottom identical with that which pervades the organic structures of the world of life. The quantum and space-time have brought physics closer to biology. As I have pointed out, the quantum anticipates some of the fundamental characters of life, while space-time forms the physical basis for organic evolution. Physics and biology are thus recognized as respectively simpler and more advanced forms of the same fundamental pattern in world-structure.

The older mechanistic conception of nature, the picture of nature as consisting of fixed material particles, mechanically interacting with each other—already rudely shaken by the relativity theory—is now being modified by the quantum physics. The attack on mechanism, thus coming from physical science itself, is therefore all the more deadly. Even in physics, organization is becoming more important than the somewhat nebulous entities which enter into matter Interaction is more and more recognised to be not so much mechanical as organic or holistic, the whole in some respects dominating not only the functioning but the very existence of the entities forming it The emergence of this organic view of nature from the domain of physics itself is thus a matter of first-rate importance, and must have very far-reaching repercussions for our eventual world-view

The nature of the organic whole is, however, much more clearly recognized in its proper sphere of biology, and especially in the rapidly advancing science of physiology Here, too, the correct view has been much obscured by the invasion of mechanistic ideas from the physics of the nineteenth century A crude materialism all but swamped biology for more than a generation At the Belfast session of this association in 1874 a famous predecessor of mine in this chair gave unrestained expression to this materialistic creed All that is passing, if not already past It must be admitted that up to a point mechanism has been useful as a first approximation and fruitful as a convention for research purposes But if even in physics it has lost its savor, *a fortiori* has it become out of place in biology The partial truth of mechanism is always subtended by the deeper truth of organicity or holism So far from biology being forced into a physical mould, the position will in future be reversed Physics will look to biology and even to psychology for hints, clues and suggestions In biology and psychology it will see principles at work in their full maturity which can only be faintly and fitfully recognized in physics In this way the exchanges of physics, biology and psychology will become fruitful for the science of the future, and lay the basis for a new scientific monism.

A living individual is a physiological whole, in which the parts or organs are but differentiations of this whole for purposes of greater efficiency, and remain in organic continuity throughout They are parts *of* the individual, and not *independent* or self-contained units which *compose* the individual It is only this conception of the individual as a dynamic organic whole which will make intelligible the extraordinary unity which characterizes the multiplicity of functions in an organism, the mobile, ever-changing balance and interdependence of the numerous regulatory processes in it, as well as the operation of all the mechanisms by which organic evolution is brought about This conception applies not only to individuals, but also to organic societies, such as a beehive or an ants' nest, and even to social organizations on the human level

As the concept of space-time destroys the purely spatial character of things, so the concept of the organic whole must also be extended beyond the spatial limits of the organism so as to include its interaction with its environment. The stimuli and responses which render them mutually interdependent constitute them one whole which thus transcends purely spatial aspects. It is this overflow of organic wholes beyond their apparent spatial limits which binds all nature together and prevents it from being a mere assemblage of separate interacting units.

It is time, however, that we pass on to the world of mind From matter, as now transformed by space-time and the quantum, we pass step by step through organic nature to conscious mind Gone is the time when Descartes could divide the world into only two substances extended substance or matter, and thinking substance or mind There is a whole world of gradations between these two limits On Descartes' false dichotomy the separate provinces of modern science and philosophy were demarcated But it is as dead as the epicycles of Ptolemy, and ultimately the Cartesian frontiers between physics and philosophy must largely disappear, and philosophy once more become metaphysic in the original sense In the meantime, under its harmful influence, the paths of matter and mind, of science and philosophy, were made to diverge farther and farther, so that only the revolution now taking place in thought could bring them together again I believe, however, their reunion is coming fast We have seen matter and life indefinitely approaching each other in the ultimate constituents of the world We have seen that matter is fundamentally a configuration or organization of space-time, and we have seen that life is a principle of organization whereby the space-time patterns are arranged into organic unities. The next step is to show that mind is an even more potent embodiment of the organizing whole-making principle, and that this embodiment has found expression in a rising series, which begins practically on the lowest levels of life, and rises ultimately to the conscious mind which alone Descartes had in view in his classification. I have no time to follow up the matter here beyond making a few remarks.

Mind is admittedly an active, conative, organizing principle It is forever busy constructing new patterns of things, thoughts or principles out of the material of its experience Mind, even more than life, is a principle of whole-making It differentiates, discriminates and selects from its vague experience, and fashions and correlates the resulting features into more or less stable, enduring wholes Beginning as mere blind tropisms, reflexes and conditioned reflexes, mind in organic nature has advanced step by step in its creative march until in man it has become nature's supreme organ of understanding, endeavor and control—not merely a subjective human organ, but nature's own power of self-illumination and self-mastery—"The eye with which the universe beholds itself and knows itself divine"

The free creativeness of mind is possible because, as we have seen, the world ultimately consists, not of material stuff, but of patterns, of organization, the evolution of which involves no absolute creation of an alien world of material from nothing The purely structural character of reality thus helps to render possible and intelligible the free creativeness of life and mind, and accounts for the unlimited wealth of fresh patterns which mind freely creates on the basis of the existing physical patterns

The highest reach of this creative process is seen in the realm of values, which is the product of the human mind Great as is the physical universe which confronts us as a given fact, no less great is our reading and evaluation of it in the world of values, as seen in language, literature, culture, civilization, society and the state, law, architecture, art, science, morals and religion Without this revelation of inner meaning and significance the external physical universe would be but an immense empty shell or crumpled surface The brute fact here receives its meaning, and a new world arises which gives to nature whatever significance it has As against the physical configurations of nature we see here the ideal patterns or wholes freely created by the human spirit as a home and an environment for itself

Among the human values thus created science ranks with art and religion In its selfless pursuit of truth, in its vision of order and beauty, it partakes of the quality of both More and more it is beginning to make a profound esthetic and religious appeal to thinking people Indeed, it may fairly be said that science is perhaps the clearest revelation of God to our age Science is at last coming into its own as one of the supreme goods of the human race

While religion, art and science are still separate values, they may not always remain such Indeed, one of the greatest tasks before the human race will be to link up science with ethical values, and thus to remove grave dangers threatening our future A serious lag has already developed between our rapid scientific advance and our stationary ethical development, a lag which has already found expression in the greatest tragedy of history Science must itself help to close this dangerous gap in our advance which threatens the disruption of our civilization and the decay of our species. Its final and perhaps most difficult task may be found just here. Science may be destined to become the most effective drive towards ethical values, and in that way to render its most priceless human service. In saying this I am going beyond the scope of science as at present understood, but the conception of science itself is bound to be affected by its eventual integration with the other great values

I have now finished my rapid and necessarily superficial survey of the more prominent recent tendencies in science, and I proceed to summarize the results and draw my conclusions, in so far as they bear on our world-picture

In the first place we have seen that in the ultimate physical analysis science reaches a microscopic world of scientific entities, very different in character and behavior from the macroscopic world of matter, space and time The world of atoms, electrons, protons, radiations and quanta does not seem to be in space-time, or to conform to natural law in the ordinary sense The behavior of these entities can not be understood without the most abstruse mathematics, nor, apparently, without resort to epistemological considerations We seem to have passed beyond the definitely physical world into a twilight where pro-physics and metaphysics meet, where space-time does not exist, and where strictly causal law in the old sense does not apply From this uncertain nebulous underworld there seems to crystallize out, or literally to materialize, the macroscopic world which is the proper sphere of sensuous observation and of natural laws The pre-material entities or units condense and cohere into constellations, which increase in size and structure until they reach the macroscopic stage of observation As the macroscopic entities emerge, their space-time field and appropriate natural laws (mostly of a statistical character) emerge *pari passu* We seem to pass from one level to another in the evolution of the universe, with different units, different behaviors—and calling for different concepts and laws Similarly, we rise to new levels as later on we pass from the physical to the biological level, and again from the latter to the level of conscious mind But—and this is the significant fact—all these levels are genetically related and form an evolutionary series; and underlying the differences of the successive levels, there remains a fundamental unity of plan or organization which binds them together as members of a genetic series, as a growing, evolving, creative universe

In the second place let us see how common sense deals with this macroscopic world On this stage common sense recognizes three levels of matter, life and mind as together composing the world. But it places them so far apart and makes them so inherently different from each other that relations between them appear unintelligible, if not impossible The common-sense notions of matter, life and mind make any relations between them, as well as the world which they form, an insoluble puzzle. The older science therefore attempted to reduce life substantially to terms of matter, and to put a question mark behind mind; and the result was a predominantly materialistic view of the world The space-time relativity concept of the world has overcome the difficulty by destroying the old concept of matter, and reducing it from a self-subsistent entity to a configuration of space-time —in other words, to a special organization of the basic world-structure If matter is essentially immaterial structure or organization, it can not fundamentally be so different from organism or life, which is best envisaged as a principle of organization, nor from mind, which is an active organizer Matter, life and mind thus translate roughly into organization, organism, organizer The all-or-none law of the quantum, which also applies to life and mind, is another indication that matter, life and mind may be but different stages or levels of the same activity in the world which I have associated with the pervading feature of whole-making Materialism has thus gone by the board, and the unintelligible trinity of common sense (matter, life, mind) has been reinterpreted and transformed and put on the way to a new monism

In the third place, the iron determination of the older science, so contrary to direct human experience, so destructive of the free activity of life and mind, as well as subversive of the moral responsibility of the individual, has also been materially recast It was due to the Newtonian causal scheme which, as I have indicated, has been profoundly shaken by recent developments Relativity reduces substance to configuration or patterns, while quantum physics gives definite indications of indeterminism in nature In any case, life through the ages shows clearly a creative advance to ever more complex organization, and ever higher qualities, while mind is responsible for the creation of a whole realm of values. We are thus justified in stressing, along with natural necessity, an increasing measure of freedom and creativeness in the world, sufficient at least to account for organic evolution and for the appearance of moral law and endeavor This liberation of life and spirit from the iron rule of necessity is one of the greatest gains from the recent scientific advances Nature is not a closed physical circle, but has left the door open to the emergence of life and mind and the development of human personality It has, in its open flexible physical patterns, laid the foundation and established the environment for the coming of life and mind The view, to which Huxley once gave such eloquent and poignant expression, of a dualism implanted in the heart of nature, of a deadly struggle between cosmic law and moral law, is no longer justified by the subsequent advances of science.

But, in the fourth place, another dualism of a wider reach has appeared, which makes the universe itself appear to be a house divided against itself. For while the stream of physical tendency throughout the universe is on the whole downward, toward disintegration and dissipation, the organic movement, on this planet at least, is upward, and life structures are on the whole becoming more complex throughout the course of organic evolution From the viewpoint of physics, life and mind are thus singular and exceptional phenomena, not in line with the movement of the universe as a whole Recent astronomical theory has come to strengthen this view of life as an exceptional feature off the main track of the universe. For the origin of our planetary system is attributed to an unusual accident, and planets such as ours with a favorable environment for life are taken to be rare in the universe Perhaps we may even say that at the present epoch there is no other globe where life is at the level manifested on the earth Our origin is thus accidental, our position is exceptional, and our fate is sealed, with the inevitable running down of the solar system Life and mind, instead of being the natural flowering of the universe, are thus reduced to a very casual and inferior status in the cosmic order A new meaning and a far deeper poignancy are given to Shakespeare's immortal lines

> We are such stuff
> As dreams are made of, and our little life
> Is rounded with a sleep

According to astronomy, life is indeed a lonely and pathetic thing in this physical universe—a transient and embarrassed phantom in an alien, if not hostile, universe

Such are some of the depressing speculations of recent astronomical theory But in some respects they have already been discounted in the foregoing. For even if life be merely a terrestrial phenomenon, it is by no means in an alien environment if, as we have seen reason to think, this is an essentially organic universe In its organic aspects the universe is on the way to life and mind, even if the goal has been actually reached at only one insignificant point in the universe. The potencies of the universe are fundamentally of the same order as its actualities. The universe might say in the words of Rabbi Ben Ezra:

> All I could never be
> All man ignored in me,
> This I was worth to God.

Then again, the very possibility of perception, of knowledge and science depends on an intimate relation between mind and the physical universe. Only thus can the concepts of mind come to be a measure for the facts of the universe, and the laws of nature [illegible] to be revealed and interpreted by nature's own organ of the human mind. Besides science we have other forms of this inner relation between the mind and the universe, such as poetry, music, art and religion. The human spirit is not a pathetic wandering phantom of the universe, but is at home, and meets with spiritual hospitality and response everywhere. Our deepest thoughts and emotions and endeavors are but responses to stimuli which come to us, not from an alien, but from an essentially friendly and kindred universe. So far from the cosmic status of life and mind being degraded by the newer astronomy and physics, I would suggest an alternative interpretation of the facts, more in accord with the trend of evolutionary science. We have seen a macroscopic universe born or revealed to consciousness out of a prior microscopic order of a very different character. Are we not, in the emergence of life and mind, witnessing the birth or revelation of a new world out of the macroscopic physical universe? I suggest that at the present cosmic epoch we are the spectators of what is perhaps the grandest event in the immeasurable history of our universe, and that we must interpret the present phase of the universe as a mother and child universe, still joined together by a placenta which science, in its divorce from the other great values, has hitherto failed to unravel.

Piecing together these clues and conclusions we arrive at a world-picture fuller of mystery than ever. In a way it is closer to common sense and kinder to human nature than was the science of the nineteenth century. Materialism has practically disappeared, and the despotic rule of necessity has been greatly relaxed. In ever varying degree the universe is organic and holistic through and through. Not only organic concepts, but also, and even more so, psychological viewpoints are becoming necessary to elucidate the facts of science. And while the purely human concepts, such as emotion and value, purpose and will, do not apply in the natural sciences, they retain their unimpaired force in the human sciences. The ancient spiritual goods and heirlooms of our race need not be ruthlessly scrapped. The great values and ideals retain their unfading glory and derive new interest and force from a cosmic setting. But in other respects it is a strange new universe, impalpable, immaterial, consisting not of material or stuff, but of organization, of patterns or wholes which are unceasingly being woven to more complex or to simpler designs. In the large it appears to be a decaying, simplifying universe which attained to its perfection of organization in the far-distant past and is now regressing to simpler forms—perhaps for good, perhaps only to restart another cycle of organization. But inside this cosmic process of decline we notice a smaller but far more significant movement—a streaming, protoplasmic tendency, an embryonic infant world emerging, throbbing with passionate life, and striving towards rational and spiritual self-realization. We see the mysterious creative rise of the higher out of the lower, the more from the less, the picture within its framework, the spiritual kernel inside the phenomenal integuments of the universe. Instead of the animistic, or the mechanistic, or the mathematical universe, we see the genetic, organic, holistic universe, in which the decline of the earlier physical patterns provides the opportunity for the emergence of the more advanced vital and rational patterns.

In this holistic universe man is in very truth the offspring of the stars. The world consists not only of electrons and radiations, but also of souls and aspirations. Beauty and holiness are as much aspects of nature as energy and entropy. Thus "in eternal lines to time it grows." An adequate world-view would find them all in their proper context in the framework of the whole. And evolution is perhaps the only way of approach to the framing of a consistent world-picture which would do justice to the immensity, the profundity and the unutterable mystery of the universe.

Such in vague outline is the world-picture to which science seems to me to be pointing. We may not all agree with my rendering of it, which indeed does not claim to be more than a mere sketch. And even if it were generally accepted, we have still to bear in mind that the world-picture of to-morrow will in all probability be very different from any which could be sketched to-day.

SCIENTIFIC EVENTS

THE NATIONAL METAL CONGRESS

The Review, official journal of the American Society for Steel Treating, reports the meeting of the National Metal Congress at Boston, from September 21 to 25. The Institute of Metals and the Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers met jointly at the Hotel Statler.

The officers of the Institute of Metals Division were: Sam Tour, *chairman;* Zay Jeffries, *past chairman;* J. R. Freeman, Jr., and C. H. Mathewson, *vice-chairmen,* and William M. Corse, *secretary-treasurer.* John L. Christie and E. M. Wise, respectively chairman and vice-chairman of the papers and publications committee of the division, were active in organizing the technical program for the meeting. The officers of the Iron and Steel Division were: F M. Becket, *chairman*, W J. MacKenzie, *past chairman;* C B Murray, W E Ruder and F N Speller, *vice-chairmen*, and A B Kinzel, *secretary* The program committee of this division consisted of C E Meissner, *chairman*, Walter Crafts, G B Waterhouse and Clyde E Williams

Members of the American Institute of Mining and Metallurgical Engineers registered outside the Georgian Room of the Hotel Statler on Monday morning. Starting on Tuesday morning there were six technical sessions, for which there were 23 important papers. On Thursday afternoon Dr P W Bridgman, Hollis professor of mathematics and natural philosophy at Harvard University, presented the science lecture. His subject was "Recently Discovered Complexities in the Properties of Simple Substances" On Friday afternoon R J Cowan presented a paper on "The Development of Continuous Gas Carburizing," at a joint session of the American Society for Steel Treating and the Iron and Steel Division, at which the principal topic was nitriding and carburizing

The Society of Automotive Engineers cooperated with other engineering societies by having a technical session at the National Metal Congress in connection with an exhibition Technical sessions were held in the Georgian Room of the Hotel Statler on Wednesday morning, September 23 F P Gilligan, chairman of the Iron and Steel Division of the standards committee, presided He had been active for many years in the society's work and is a past president of the American Society for Steel Treating

The program of the session comprised three timely papers on important subjects, two of which dealt with the methods and costs of heat treating and made available valuable information bearing more on the economics of the subject than on its purely metallurgical phases One of these two papers was presented by E F. Davis, the metallurgist of the Warner Gear Company, and the other by Dr Haakon Styri, of SKF Industries, Inc The third paper at the sessions, which was read by F W Shipley, foundry metallurgist of the Caterpillar Tractor Company, was devoted to the metallurgical characteristics and advantages of alloyed cast irons, particularly for use in cylinder castings The number of papers given at this session was limited by the society so that each might be presented in full and ample time allowed for general discussion

The American Welding Society offered a technical program for their sessions at the congress. All their sessions were held at the Copley Plaza Hotel.

CLINICAL CONGRESS OF THE CONNECTICUT STATE MEDICAL SOCIETY

THREE hundred physicians were expected to attend the seventh annual Clinical Congress of the Connecticut State Medical Society, which was held at New Haven from September 22 to 24. Dr. Creighton Barker was chairman of the committee on enrolment. Equal emphasis and time were given this year to demonstrations and lectures, according to Dr Barker. In general, morning meetings were devoted to presentation of papers and afternoon meetings to demonstrations of the subjects treated in the papers All morning and afternoon sessions were concentered at the Yale School of Medicine for the first time in the history of the congress, and this proved to be a timesaver and convenience to those in attendance.

Of unusual interest was an address on infantile paralysis by Dr William H Park, of the New York City Department of Health This paper, in which Dr. Park discussed findings in regard to the prevalence and spread of this disease and measures to be employed in controlling it, was given on Wednesday, at which time diphtheria control also was discussed by Dr. Park and by others, including Dr Stanley H. Osborn, state commissioner of health of Connecticut, Dr John L Rice, health officer of New Haven, and Dr William F Wild, health officer of Bridgeport

General interest centered on an address to be given by Dr Linsly R Williams, director of the New York Academy of Medicine, on the subject, "Is Medical Service a Necessity?" This address was given at a dinner meeting held on Tuesday evening at the New Haven Lawn Club, with Dr Charles C. Gildersleeve, of Norwich, president of the State Medical Society, presiding

The following papers were presented on Tuesday: "Medicinal Foods," by E Monroe Bailey, chemist, "Tumors of the Large Bowel," by Dr Daniel F Jones, and "Functional Gastro-Intestinal Disturbances," by Dr Thomas R Brown In the afternoon group discussions of these papers were led by Dr. Brown, Dr. Eugen Kahn, Dr Jones and Dr. Joseph I Linde, after which the following demonstrations were given: Medicinal foods, Dr Bailey; gastric pouch experiments, Dr George R Cowgill, vitamin deficiencies, Dr. Lafayette B. Mendel; pathological lesions, Dr. Samuel C. Harvey and staff, and Dr. Raymond G. Hussey and staff, gastro-intestinal studies, Dr. William A. LaField and staff, test meal, Dr. Albert J. Sullivan; dental pathology, Dr Bert G. Anderson; hypodermoclysis, Dr Grover F Powers and staff; congenital anomalies of the digestive tract, Dr. Ethel C Dunham, carcinoma of the stomach, Dr. Ashley W. Oughterson The dinner meeting, addressed by Dr. Williams, began at seven o'clock.

Papers given on Wednesday morning include: "Fractures of the Lower Extremity," by Dr. Philip Wilson, "Fractures of the Upper Extremity," by Dr. Clay R. Murray; "The Control of Diphtheria by Bacteriological and Immunological Methods," by Dr.

Park; "Epidemiological Studies of Diphtheria Control," by Dr. Edward S Godfrey; "Diphtheria in Connecticut," by Dr Osborn, "Results in Bridgeport," by Dr. Wild; "Results in New Haven," by Dr Rice.

In the afternoon a clinical pathological conference was led by Dr. Francis G Blake and staff, and a round table discussion by Dr C-E A Winslow and staff The dinner meeting at the New Haven Lawn Club was addressed by Dr Theodore T Zuck, of Cleveland, on "Maternal Health in Relation to Race Betterment"

Marital maladjustments were discussed on Thursday morning by Dr William B Terhune, of the Austen Riggs Foundation, and tuberculosis and pregnancy by Dr. David R Lyman, director of the Gaylord Farm Sanatorium An illustrated lecture on sterility studies was given by Dr William H Cary, of New York City Dr Robert L Dickinson, secretary of the National Committee on Maternal Health, gave a talk on "Seven Years' Research in Contraceptive Methods" The congress concluded on Thursday afternoon with a group discussion of sexual adjustment in marriage, led by Dr Josephine H Kenyon, and a discussion of sterility, led by Dr Cary

THE BRITISH INDUSTRIAL HEALTH RESEARCH BOARD

The eleventh annual report of the British Industrial Health Research Board has been published According to a summary in the London *Times* it includes an analysis of the work published during the years 1926–30, and covers the whole field of industry

It is claimed that real progress has been made in ascertaining the nature of some of the principal factors affecting human health and efficiency in industry. For example, the study of industrial fatigue in heavy work has now reached a stage which, in the opinion of the board, shows conclusively the fallacies of long hours and the benefits of suitable environmental conditions and of scientifically imposed rest pauses The fatigue with which the board is now more concerned is the mental state produced by hours of monotonous work in an industrial world of progressively mechanized production, and in this connection close analysis of the various influences operating on those engaged in uniformly repetitive work has thrown fresh light on their reactions to it, as reflected by variations in output, speed and accuracy, and as expressed by symptoms of boredom shown by the workers themselves Conclusions have been reached as to the way in which these conditions can be relieved by varying work and introducing rest pauses.

The report continues

> In a more special sphere the practical value to workers engaged in fine work of using suitable spectacles was demonstrated—the particular new point here being the benefit to be derived from these spectacles by persons possessing normal vision From the mental side, study of the incidence of nervous symptoms has served to remind those with managerial responsibility of the prevalence of workers who are temperamental misfits in their employment—and not all of them in subordinate positions
>
> With the exception of the last, the instances mentioned are illustrative of advances in knowledge concerning the effects of the factors studied on workers regarded more as groups than as individuals Reference, however, must be made to those studies dealing with the individual in relation to his occupation which are generally spoken of as vocational, and on which much of the work of the board bears On the general aspect of these problems, research for the board is still confined to fundamental investigations of personal qualities in their relation to occupational training and success The subject is vast and intricate, and though the board is convinced that as a result of these investigations improved methods of selection will eventually be devised, they are still at the stage of defining their terms In one branch of this subject—the detection of the ''accident prone'' worker—information seems to have been obtained which should be capable of practical application at no distant date. Apart from this general question of testing for personal qualities, there are particular vocational questions which have been studied but about which also insufficient knowledge has as yet been gained to afford grounds for conclusions capable of practical application. Among these may be instanced the occupational fitness of mental defectives, and the preliminary study, already referred to, of those whose temperaments render them liable to nervous symptoms affecting their vocational fitness It is in such types that are likely to be found the most noticeable reactions to various disturbing conditions of environment, such as noise, which are now being investigated.

SCIENTIFIC NOTES AND NEWS

Dr. David Starr Jordan, chancellor emeritus of Stanford University and eminent ichthyologist, died on September 19 at the age of eighty years.

The Grasselli Medal will be presented to Dr. L. V. Redman at a joint meeting of the Society of Chemical Industry with the New York section of the American Chemical Society, American Electrochemical Society and Société de Chimie Industrielle on November 6 The award has been made for his paper entitled "Cost of Research and its Apportionment," which was presented at a meeting of these societies on December 9, 1927.

Dr. Shirley W Wynne, health commissioner of New York City, was presented with a silver plaque by members of the staff of the department of health to commemorate his twenty-five years of service in the department

Professor Bradley Stoughton, head of the department of metallurgy at Lehigh University, has been elected president of the Electrochemical Society for the year 1931–1932

Dr Walter T Dannreuther, professor of gynecology in the New York Post-Graduate Medical School, was elected president of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons, at their fifty-fourth annual meeting on September 15 He will succeed Dr Arthur Holbrook Bill, of Cleveland Other officers elected were *First vice-president,* Dr Herbert M Little, of McGill University, *second vice-president,* Dr Andre Crotti, of the Medical School of Ohio State University, *secretary,* Dr Magnus A Tate, of Cincinnati, *assistant secretary,* Dr A M Mendenhall, of Indianapolis, *executive council,* Dr Palmer Findlay, of Omaha, and Dr Arthur H Bill, of Cleveland Dr Ludwig Adler, of the University of Vienna, professor of gynecology in the Wilhelminenspital, Vienna, was elected an honorary fellow of the association, making the eleventh honorary fellow of foreign countries As guest speaker, he gave an address on "The Treatment of Carcinoma"

H Malcolm Read, of York, was elected president of the Pennsylvania State Homeopathic Medical Society at the sixty-eighth annual meeting of the society, which was held in Pittsburgh on September 17 Dr John D Kistler, of Pittsburgh, was retiring president, William M Hillegas, of Philadelphia, and E H Douds, of Beaver Falls, were chosen trustees Officers elected are as follows George G Shoemaker, of Pittsburgh, *first vice-president,* William Doebele, of Huntingdon, *second vice-president,* C F Cutteroff, of Philadelphia, *secretary,* Anna Johnston, of Pittsburgh, *treasurer,* George A Hopp, of Philadelphia, *necrologist,* and I L Moyer, of Columbia, *censor*

Dr Max C Starkloff, city health commissioner in St. Louis, Missouri, for thirty years, was made president of the International Society of Medical Health Officers during the recent meeting at Montreal

Those who will be new on the faculty at Yale University this year include Dr Edward Sapir, of the University of Chicago, Sterling professor of anthropology and linguistics and chairman of the department of social sciences, Dr Walter R Miles, of Stanford University, professor of experimental psychology; Howard Edward Boardman, of the Boston and Maine Railroad, Dudley professor of railroad engineering, Robert Ernest Doherty, of the General Electric Company, professor of electrical engineering

Additions to the faculty of Columbia University include Alan R Anderson, associate director of the New York Post-Graduate Medical School, Boris A Bakhmeteff, professor of civil engineering, Erwin Brand, associate professor of biological chemistry, school of medicine, Clarence Orion Chene, professor of clinical psychiatry, school of medicine, William Morris Davis, visiting professor of physiography during the winter session, Frederick L Fitzpatrick, associate professor of natural sciences in Teachers College, Edward Hicks Hume, director of the New York Post-Graduate Medical School, Alfred L. Kroeber, visiting professor of anthropology during the spring session, Henry Lea Mason, assistant professor of mechanical engineering, Jan Schilt, associate professor of astronomy, and Ramon J Sifre, associate professor of hygiene and public health in the school of tropical medicine

The following appointments have been made at the University of Maryland Dr R C Yates, assistant professor of mathematics, Dr Glenn A Greathouse, assistant professor in plant physiology, Norman E. Phillips, assistant professor in zoology, and Dr Ronald Bamford, assistant professor in botany

Dexter S Kimball, Jr, has been appointed assistant professor of industrial engineering at Cornell University Promotions from instructor to assistant professor include R P Agnew, mathematics, A B Burrell, plant pathology, G A Knaysi, Jr., bacteriology, and M G Northrop, electrical engineering

Dr A John Schwarz has been promoted to the rank of associate professor of botany and pharmacognosy, in the division of pharmacology of the Memphis branch of the University of Tennessee

Dr Robert Burri, director of the Swiss Federal Dairy Research Institute, Berne, Liebefeld, Switzerland, and Dr Otto Baumecker, of the Federation of Westphalian Landowners Organizations, Hamm, Westphalia, recently visited the U S Bureau of Dairy Industry in Washington as part of their investigations of dairy conditions in this country Dr Burri officially represented the League of Nations for the study of dairy sanitation and milk control. Dr Baumecker was especially interested in dairy sanitation and cooperative marketing of dairy products.

Dr. Christian Richard Thurnwald, of the University of Berlin, Bishop Museum visiting professor of anthropology, will give instruction and direct research at Yale University in the problems of the

Pacific area under the terms of the agreement by which Yale and the Bishop Museum of Honolulu are affiliated

Dr. Ervin R Van Der Jagt and Harry L Kutz will succeed Jacob C Sparrow and Harry J Clausen in the department of biology at Norwich University

Dr Lewis J Moorman, professor of clinical medicine at the University of Oklahoma School of Medicine, has been made dean in succession to Dr Leroy U Long

Dr. Allen F Voshell has been appointed professor of orthopedic surgery at the University of Maryland, and has also become surgeon-in-chief at the James Lawrence Kernan Hospital for Crippled Children Dr Charles Bagley, Jr, has been appointed professor of neuro-surgery at the University of Maryland

Dr Leon J Menville, of New Orleans, has been made editor of *Radiology*, the journal of the Radiological Society of North America He has succeeded Dr Maximilian J Hubeny, of Chicago

Mr J E Flanders has been appointed chief engineer of the Missouri Public Service Commission to succeed Mr F M Plake

Dr Kotaro Honda has been elected president of the Tohoku Imperial University at Sendai, Japan Dr Honda was professor of physics at Tohoku Imperial University and director of the research institute for iron, steel and other metals at the university

The following changes have been made at the University of Cambridge Dr A Harker has resigned his readership in petrology in St John's College, Dr F R Winton has been appointed university lecturer in physiology in Clare College, and Dr E G Holmes has been appointed university lecturer in pharmacology in Christ's College

Dr Charles Singer, lecturer in the history of science at University College, London, who made an extensive lecture trip in the United States in 1929, expects to spend the winter of 1931-32 at the University of California at Berkeley Between April 20 and May 20, 1932, Dr and Mrs Singer expect to lecture at a number of American colleges and universities Inquiries as to their schedule may be made of Dr George W Corner, School of Medicine and Dentistry, University of Rochester, Rochester, New York

Professor Herbert Graham Cannon, professor of zoology at Sheffield University since 1926, has retired

Sir William Dampier has been appointed secretary of the Agricultural Research Council, England, and Mr. E H E Havelock has been appointed assistant secretary.

The sixth annual William deMille Campbell memorial lecture of the American Society of Steel Treating was presented in Boston on the morning of September 23 in the ballroom of the Hotel Statler by Dr C. H. Herty, Jr, supervising chemist in charge of the metallurgical section of the U S Bureau of Mines Experiment Station in Pittsburgh The first Campbell lecture was delivered in 1926 by Wilhelm M Guertler, associated with the Metall-Institut der Technischen Hochschule in Berlin Succeeding lectures and their topics have been 1927—"Contribution to the Theory of Hardening and the Constitution of Steel," by Dr Zay Jeffries, consultant, Aluminum Company of America and General Electric Company, 1928—"Application of Science to the Steel Industry," by Dr W H Hatfield, Brown-Firth Research Laboratories, Sheffield, England, 1929—"Steel at Elevated Temperatures," by Dr Albert Sauveur, Gordon McKay professor of metallurgy and metallography, Harvard University, 1930—"Oxygen in Steel," by Dr M A Grossmann, director and vice-president, Republic Research Corporation, at Canton, Ohio

The fourth annual meeting and conference of the committee on electrical insulation, of the division of engineering and industrial research of the National Research Council, will be held at Harvard University on November 13 and 14 There will be three technical sessions with papers on the physics and chemistry of dielectrics and on recent progress in engineering research in the field of dielectrics, as applied to the insulation of electric circuits A dinner on the evening of November 13 will be followed by a lecture dealing with recent advances in dielectric theory Dr J B Whitehead, of Johns Hopkins University, is chairman of the committee

The second International Congress on the Rat and Plague will be held in Paris from October 7 to 12. Professor Gabriel Petit is secretary of the congress.

The *British Medical Journal* reports that the second International Congress of Comparative Pathology will be held in Paris at the Faculty of Medicine from October 14 to 18 Professor Charles Achard will preside The subjects for discussion include B C G immunization; Brucella infections in man and animals, mineral salt deficiencies in man and animals, the distribution of the ultra-virus agencies, and the diseases attributable to them, and helminthic infections The congress is open to medical and veterinary practitioners and those interested in the diseases of plants Further information may be obtained from the general secretary, 7 Rue Gustave Nadaud, Paris, France

We learn from the *Journal* of the American Medical Association of the thirty-sixth annual meeting of the American Academy of Ophthalmology and Otolaryngology, which was held at French Lick, Indiana, from September 13 to 19, with headquarters at the French Lick Springs Hotel. The scientific program included papers by Dr. Edward Jackson, of Denver, on "Share of Crystalline Lens in Ocular Refraction"; Dr. Cecil S. O'Brien, of Iowa City, on "Astigmatism—Its Accurate Determination and Correction", Dr. Leo L. Mayer, of Chicago, "An Experimental Study of Detachment of the Retina and Its Surgical Therapy", Dr. Lyman G. Richards, of Boston, on "Prognostic Significance of Sinusitis in Children", Dr. Ernest Fulton Risdon, of Toronto, on "Management of the Fractured Nose", Dr. Albert N. B. Lemoine, of Kansas City, Missouri, on "Progress in Diagnosis and Pathology in Ophthalmology", Dr. William A. Wagner, of New Orleans, on "Diagnosis and Conservative Treatment of Sphenoid Suppuration," and Dr. John J. Shea, of Memphis, on "Nasal Obstruction and Systemic Consequences." A symposium on aviation medicine was conducted on the evening of September 15, by Dr. Louis H. Bauer, of Hempstead, N. Y., Dr. Conrad H. Berens, of New York, Dr. Harry T. Smith, of Humeston, Iowa, Dr. Ralph A. Fenton, of Portland, Oregon, and the Honorable David S. Ingalls, assistant secretary of the U. S. Navy in charge of aviation, and a dinner was given in honor of Dr. Luther C. Peter, of Philadelphia, who is retiring from the council after thirteen years of active service as acting secretary, secretary and president.

The annual general meeting of the British Dental Association, which was held at Cardiff, opened on August 26. In addition to the two hundred delegates from Great Britain, several Canadian members of the profession who attended the eighth International Dental Congress at Paris were in attendance. At the opening meeting, the Lord Mayor and the authorities of the University College of South Wales and Monmouthshire, where the conference is being held, extended a welcome to the delegates, and Mr. William Kittow, of Cardiff, was installed as president in succession to Sir Norman Bennett.

DR. C. C. LAURITSEN, of the California Institute of Technology, will shortly start in operation the world's largest and most powerful x-ray tube. The tube is approximately thirty feet long and uses 2,000,000 volts of electricity. All the work of constructing the tube was done in the shops of the institute under the direction of Dr. Lauritsen, assisted by students. Glass cylinders, twenty inches high and tapering from eighteen inches to twelve inches in diameter, form the glass exterior of the long tube. Inside are two electrodes.

DARTMOUTH COLLEGE has received $70,000 by the will of the late Dr. R. Melville Cramer.

UNDER the will of David A. Kistler, Carthage College will receive a legacy of $15,000, after the death of Mrs. Kistler.

DURING July and August Dr. Alexander Forbes, of Harvard University, carried out an expedition to Labrador in cooperation with Sir Wilfred Grenfell. The society was named the Grenfell Northern Labrador Expedition. The expedition was sponsored by the American Geographic Society, and Mr. O. M. Miller, of the society's school of surveying, was associated with Dr. Forbes as topographer in charge of surveys. The scientific personnel of the expedition also included Mr. Noel E. Odell, in charge of the geological work, and Mr. Ernst C. Abbe, botanist, representing the Gray Herbarium.

THE Mont Blanc Astronomical Observatory, built thirty years ago by Professor Vallot, has become the property of the Paris Observatory. It stands at an elevation of 14,435 feet, and will enable astronomers in Paris to undertake researches for which they have not hitherto been equipped.

THE experiments and the seed and bulb business of the late Luther Burbank will be continued by the W. Atlee Burpee Company, seed dealers of Philadelphia, it has been announced by David Burpee, president of the company. Through an agreement with Mrs. Burbank, the company has leased the Burbank property at Santa Rosa, California, and has received the famous collection of what Mr. Burbank considered his most valuable seeds for preservation from season to season. While the experiments will be continued on the ground used by Mr. Burbank and with the plants he cultivated there, Mrs. Burbank will continue to live on the property. The late W. Atlee Burpee, father of David Burpee and W. Atlee Burpee, Jr., secretary and treasurer of the firm, were cousins of Mr. Burbank. They were closely associated in experimental work. The work at Santa Rosa will be conducted by the Burpee Company in connection with its experiments at Floradale Farm, Santa Barbara County, California, and at Doylestown, Pennsylvania.

THE Associated Press reports the discovery of six steep-walled, narrow canyons, announced by Dr. Frederick J. Pack, head of the department of geology of the University of Utah. It is believed that Dr. Pack's party was the first ever to descend into them. The newly explored canyons are said to rival the famous Zion Canyon for gorgeous colorings and unusual formations. There are sheer bare-faced cliffs of 2,300 to 3,000 feet in height, varying in length and spreading along a distance of three to five miles. In places some are so narrow that a person with outstretched arms can touch either side.

DR. A. C. MCFARLAN, professor and head of the department of geology at the University of Kentucky, has spent the greater part of the summer studying the ordovicious stratigraphy of several counties in the Blue Grass, and identifying the different formations outcropping in various communities, in an attempt to correlate them with known formations elsewhere. Clark, Anderson, Scott, Campbell, Pendleton and Grant Counties have been visited and the study of these counties will be compared with compiled information on the stratigraphy of southern Ohio, Indiana and central Tennessee, in an attempt to work out the early geographic history of the area and the nature of existent life at that time.

THE small auxiliary schooner, *Aleda*, owned by John Lippincott, of the Corinthian Yacht Club, Philadelphia, has sailed with fifteen Princeton students from Halifax for the west coast of Newfoundland, where an extensive study will be made of iron ore and chrome deposits, and the shore line itself. The *Aleda*, which is manned by the students, is commanded by Mr. Lippincott. The expedition is under the direction of Dr. A. K. Snelgrove, instructor in the department of geology, and John Streeter, psychologist, of Princeton University. After a month in the north, the party will return to New York.

ADDITIONS to the collections of the British Museum (Natural History), South Kensington, include the skin and skull of a young Menelek's bushbuck, shot at Mennegesha in Abyssinia, presented by the Duke of Gloucester. Ninety-five heads and skulls of Asiatic and American ungulates and carnivora have been selected from the collection of the late Mr. C. St. George Littledale. In addition to three record heads, the collection contains a number of exceptionally fine specimens, including the skull of a wild camel from Lob Nor in the Gobi Desert and a collection of over 60 skulls of ungulates and lions from Northern Rhodesia. The collections brought back by Mr. Bertram Thomas from the Ruba el-Khali are now being worked out, and a selection is on exhibition in the Central Hall. The 82 specimens of reptiles and amphibians represent about 25 species, some of which appear new to science. The collections include 500 entomological specimens. All the larger orders of insects are represented in about 120 species, of which some 20 appear to be new to science. A large collection of mammals has been received from the Game Department of Uganda, collected for the most part by Mr. J. Jardine. The museum has also obtained a further abnormal tusk of a Uganda elephant from Mr. W. A. Bowring, of Gibraltar. An unusual type of stony meteorite which fell at Karoonda, South Australia, on November 25 last has been given to the Mineral Department by Professor Kerr Grant, of the University of Adelaide.

DISCUSSION

EXPULSION OF GAS AND LIQUIDS FROM TREE TRUNKS

ABELL and Hursh's recent paper on gas and water pressure in oaks[1] recalls some observations made on three days in July, 1916, but hitherto unpublished. At that time I was engaged in making a study of the growth of standing trees at elevations of about 1,500–2,000 feet in Letcher County, Kentucky, the increment borer being used in this work. Inasmuch as these few observations include species of other genera than oak, they are here offered as a further contribution to the subject.

In one instance, as the increment-borer bit was withdrawn from a tree of black gum (*Nyssa sylvatica*), a pronounced blast of gas expelled some of the wood dust perhaps three inches from the 0.6-inch bark. This tree was 14 inches in diameter at breast height, 16 at the level of boring, and about 135 years old at this level. The bit had penetrated 4 inches through solid wood to a somewhat decayed heart.

While a boring was being made in a red oak (*Quercus rubra*, 13 inches in diameter at breast height, 15 at the level of boring) an outward blast started which increased suddenly and explosively when the increment-borer bit was withdrawn. The tree was 42 years old at this height, and apparently sound for the outer 3 inches of core.

In the case of a chestnut tree (*Castanea dentata*), 15 inches in diameter at breast height, 18 at the level of boring, a stream of discolored liquid was expelled a maximum distance of 30 inches, the flow lasting 20 seconds. When a boring was made 1 inch above the first hole, liquid flowed out of the lower hole for 90 seconds. The tree was 34 years old at the height of the upper hole and the wood was sound for 4 inches of radius. There had been rain the preceding night.

In the case of a hickory tree (*Hicoria glabra* ?; 21 inches at breast height, 25 at the level of boring), liquid began running out during the boring and became a considerable stream when the bit was withdrawn Gas expulsion, indicated by bubblings, continued for 5 minutes or more The age at the boring level was 58 years The outer 4 inches of core was apparently sound

---

[1] C. A. Abell and C. R. Hursh, "Positive Gas and Water Pressure in Oaks," SCIENCE, 73: 499, 1931.

The gas pressure in a hollow hickory tree blew a 2-inch section of wood out of the end of the increment-borer bit This tree was 11 inches in diameter at breast height, 14 at the boring level

It is to be noted that these trees, like those mentioned by Abell and Hursh, were all dicotyledonous Angiosperms, and all defective Except for the last-mentioned all the manifestations above recorded were observed in the morning The trees in which such phenomena occurred constituted a relatively small proportion of those bored, but no precise figures on this phase of the study are now available

FERDINAND W HAASIS

CARNEGIE INSTITUTION OF WASHINGTON

CATFISH FEEDING ON THE EGGS OF THE HORSESHOE CRAB, LIMULUS POLYPHEMUS

THE horseshoe or king crab, *Limulus polyphemus*, is very common along the gulf coast of southern Florida It lives in mud or sand just below low tide level, and never leaves this except in early spring when in great numbers it comes inshore to spawn in the sand near high water mark The female in the lead, followed by one or more males, excavates a shallow hole in the sand in which the eggs are deposited and covered with milt The eggs are about 2 mm in diameter, are pale Nile-green in color, are laid singly and are not protected by any gelatinous mass or capsule They hatch within three to six weeks, after which time the young may be seen making their way to deeper water

Early in April, 1930, while collecting mollusks on a sandy flat near the mouth of the Caloosahatchee River, my attention was attracted by a great commotion involving a considerable area of shallow water Here were hundreds of spawning *Limulus* attacked by other hundreds of catfish which were voraciously and joyously devouring the eggs as fast as deposited Each spawning female king crab and her attending males were surrounded by many catfish in groups which may perhaps best be described as "bouquets" or "rosettes" These catfish stood almost vertically on their heads, with their tails out of water, whipping the surface of this into a maelstrom in their ecstasy of feeding Crabs and catfish were pushed and shouldered about by other fish circling about the groups in a determined effort to reach the feast Literally hundreds of both horseshoe crabs and fish were concerned in this phenomenon which was watched until the rising tide made further observation impossible

But one other observation (and it an incomplete one) of this kind seems to be on record, and it as far back as 1897 In the *American Naturalist* for this year (vol 31, p 347–348) H. C Warwell records his observations on "Eels Feeding on the Eggs of *Limulus*" He states that in 1892 or 1893, in the latter part of May he was walking about dusk along the Kickemuit River between Warren and Bristol, Rhode Island, when he noticed many king crabs or "horse-feet" as he calls them, crawling on the sandy bed of the river Here are his own words

> The tide was high, and they [the "horse feet"] had come in from the outside, as is their habit at high water. What attracted my attention the most was the fact that, as they lay there on the river bottom, many eels had worked their way into the clefts between their heads and abdominal regions, and were apparently feeding Some of the eels were very large, and made a strange sight with their heads under the shell [of a crab] and their tails sticking out sideways Sometimes two or three were under one horse foot, and if I had had an eel spear I could have caught a good mess I have since wondered what the eels were eating Sometimes I think it might have been something on which the horse feet were feeding, but my uncle, who was with me, said that they were after the spawn, and I have since come to the conclusion that he was right, for it was the spawning season, and the eels were only gathered around the large female horse-feet

In the light of my observation it would seem to be clear that the eels were feeding on the eggs of the horseshoe crabs, and that at the breeding season the eggs of these crabs are preyed on extensively by predatory fishes

LOUISE MERRIMON PERRY

SANIBEL, FLORIDA

THE LACK OF CORRELATION BETWEEN ANEMIA AND THE PELLAGRA-LIKE SYMPTOMS IN RATS[1]

IN a recent article Bliss[2] has presented evidence claiming to show that pellagra as it exists in humans, and black-tongue of dogs—which is considered to be analogous to human pellagra—are both due to iron deficiency He points out that pellagra is more prevalent among women than among men, resulting possibly from the loss of iron by women in menstruation. He calls attention to the fact that the foods rich in vitamin G and in the black-tongue preventive factor are almost without fail rich in iron—liver, egg yolk, beef and yeast Further, he states that in Goldberger's work "those diets which prevented or cured black-tongue in dogs are just those to which had been added syrup iodid of iron USP." This was added to improve the mineral composition of the diet. The author states that the results of iron therapy have been studied by him on fifty-one cases of human pellagra and they are of an encouraging nature. Moreover, he has been able to cure black-tongue in dogs by giving iron intravenously.

---

[1] Published by permission of the director, Journal Article No 61 (n. s).

[2] Sidney Bliss, SCIENCE, 72: 577, 1930.

The correlation between the iron and the vitamin G content of certain foods is striking. In addition to the above-mentioned foods it is known that spinach, leaves of velvet beans and soy beans, pig's liver and even the Minot and Murphy liver extract are good sources of the vitamin. However milk which is a rich source of vitamin G is relatively low in iron, and molasses, which forms a staple article of diet among poor farmers in the South, is rich in iron.

Whether or not the vitamin which prevents the pellagra-like condition and promotes growth in rats is identical with a factor preventing human pellagra has not been determined. Aykroyd[3] recently has shown that maize contains about as much vitamin B_2 (G) as rice and millet, as measured by the rat-growth method, but people who live largely on rice are not pellagrous, while the disease is prevalent among maize-eating peoples.

In this laboratory we have been conducting experiments to determine the vitamin G (B_2) content of some foods and of various preparations. Rats were used, and the basal diet contained ferric citrate in such amounts that there was present 0.29 mg of iron in each gram of diet. In every litter of animals used for experimental work one rat was maintained on the basal diet alone as a negative control, and the food consumed by these animals even when sick was rarely less than 1.5–2 grams daily. Out of thirty-three of these negative controls only three have failed to show evidence of dermatitis in eight weeks. In most cases the condition was evident in three or four weeks. None of the animals gained more than ten grams in eight weeks, and the majority lost from five to ten grams. From this evidence it would seem that the animals were deficient in vitamin G (B_2). Throughout the experimental period, moreover, the animals were housed in metal cages and in many cases the iron was exposed. In addition, the loose screen bottom of the cage was raised above the pan by means of an iron ring. While no copper was given as such it seems possible that from the cages and from the salts used in the diet sufficient copper may have been present to satisfy the needs of the animals.

In order to satisfy ourselves on this point, however, six animals were given 0.5 mg of iron and 0.1 mg of copper daily six days a week as $FeCl_3$ and $CuSO_4$ solutions, respectively, as recommended by Steenbock.[4] Three of the animals had been maintained for ten weeks on the experimental diet alone, and they were in a very poor condition. The other three were young rats which had just been depleted of their store of the vitamin. The solutions were given as the only supplement to the basal diet and they were well eaten, and when given in addition to the iron and presumably copper present in the diet would seem to have been sufficient to prevent anemia. In neither group, however, was there any improvement due to iron therapy. The rats which had severe dermatitis did not improve and the second group began to show evidence of vitamin G (B_2) deficiency in about four weeks. In no case was there a gain in weight such as was seen in the experiments reported by Steenbock and which might have been expected had the animals been anemic.

It seems probable therefore that if human pellagra and black-tongue of dogs are shown to be iron deficiency diseases, the pellagra-like symptoms which manifest themselves as a result of vitamin G (B_2) deficiency in rats are not analogous to the other conditions.

NELLIE HALLIDAY
MICHIGAN AGRICULTURAL EXPERIMENT
STATION

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A LIGHT FILTER FOR MICROSCOPES

IN microscopes there are two points where light filters can be introduced without being imaged and yet produce equal filtering power throughout the field. These positions are known as the entrance pupil and the exit pupil. The entrance pupil is the aperture of the substage condenser where the iris diaphragm is located. The exit pupil is better known as the Ramsden disc and is in the position the eye occupies when looking through the microscope. Either position is correct for a filter, but because of certain disadvantages in placing the filter at the exit pupil, all standard filters are made to occupy the entrance pupil. The disadvantages in locating the filter at the exit pupil are that it cuts down the eye distance; the filtering density must be greater to cause the same value of light filtration, and any dirt, scratches, etc., on the filter are more easily seen and may be quite annoying. A filter located at the entrance pupil has none of these disadvantages but is in an exceedingly annoying place to get at when throwing the filter on or off frequently, especially if substage lights are used. Breakage and loss is also frequent with filters in this position

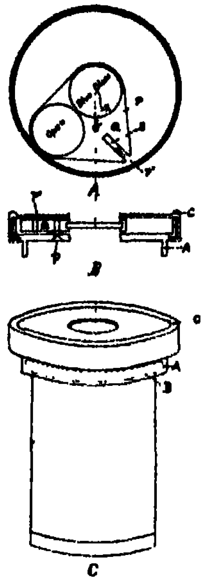
---

[3] W. R. Aykroyd, *Biochem. Jour.*, 24, No 5, 1479, 1930.

[4] E. B. Hart, H. Steenbock, J. Waddell, and C. A. Elvehjem, *Jour. Biol. Chem.*, 77: 797, 1928.

In finer cytological work, where the advantages of contrast of normal illumination with that of the shorter wave filters is appreciable, the rapid shifting of substage filters is very inconvenient The writer has therefore been using a fixture which introduces the filter at the exit pupil where it can be rapidly and conveniently thrown on or off This filter is so closely apposed to the eyepiece that the cutting down of eye distance is not appreciable The fixture also adequately protects the filter from dust, scratches and breakage It consists of a fixed cap that fits over the eyepiece To the upper surface of this piece a movable quadrant is attached in which the filter aperture and an open aperture is contained Either of these apertures can be shifted in place over the lens by simply swinging the quadrant to the right or left on its axis This is accomplished by means of a movable cap that fits over the fixed part and from which a pin fits into a slot on the quadrant Any movement of the cap to the right or left will therefore throw the quadrant and its apertures in the opposite direction.

From the diagram it will be seen that this device consists of a machined support block (A) which carries a lip that engages the knurled rim (B) of the eyepiece with a firm push fit The quadrant (Q) which carries the filter glass rotates freely about the bearing pin (P), which is fixed to the support block Another machined piece (C) (the movable block) fits concentrically over the fixed block in such a way that (C) can be rotated freely about it with the fingers The quadrant is slotted at (S) to engage a second pin (P′) fixed to the movable block



A Top view with movable cap removed B Sectional view C Eyepiece with fixture in position

In the position shown in the plan view the glass filter has been swung into position by simply turning the movable piece (C) to the right The limit of this motion is reached when the left hand edge of the quadrant abuts against the lip of the fixed block (A), as shown The radius (R) is such as to swing the filter into correct axial relationship with the eyepiece.

When the filter is not needed the movable piece is turned to the left This carries the quadrant to the right rotating about the fixed pin (P) and impelled by the movable pin (P′) The other edge of the quadrant now abuts against the rim of the block, swinging the "open" part of the quadrant into its correct position

C. E THARALDSEN

NEW YORK HOMEOPATHIC MEDICAL COLLEGE

SPECIAL ARTICLES

CONTROL OF POWDERY MILDEW AND RED SPIDER ON GREENHOUSE CUCUMBERS[1]

DUSTING greenhouse cucumbers with a high grade sulphur dust is the common method of combating powdery mildew, *Erysiphe cichoracearum* Such dusts, while generally effective, occasionally fail In an attempt to find a more efficient method of controlling the disease, cucumber vines in a commercial greenhouse were sprayed with hydrophilic colloidal sulphur, a product recently manufactured by the Ansul Chemical Company. This product is prepared in paste form and is a true hydrophilic colloid

Preliminary sprays were applied before mildew made its appearance. These were made to determine the strength of sulphur spray which greenhouse cucumber vines would tolerate and what effect hydrophilic colloidal sulphur would have on the control of red spider, *Tetranychus telarius*

The following sprays were applied March 23, 1931: 5 pounds of the colloidal sulphur to 100 gallons of water and 10 to 100 with and without 0.5 per cent. Penetrol.

An examination of the vines several days later showed that all sprays gave a perfect kill of spider. The 5 to 100 sulphur sprays caused slight leaf injury and the 10 to 100, rather severe leaf injury. Both sprays with Penetrol as a spreader caused severe leaf injury.

---

[1] Published with the approval of the director of the Ohio Agricultural Experiment Station.

Following this first attempt it seemed advisable to try a series of sprays with less colloidal sulphur. Four strengths were used: 0.5, 1.0, 2.0, and 4.0 pounds. Four applications of these sprays were made on the following dates: April 11, 20, 27 and May 4. These sprays had no harmful effect on the plants. The 4–100 and 2–100 gave excellent commercial control of spider. Less satisfactory results were obtained with the 1–100 and the 0.5–100 gave very little control. By this time mildew had made its appearance and the plants sprayed with a 1–100 spray or stronger were free of the disease.

On May 4 the manager of the greenhouse became interested and wanted to try some of the colloidal sulphur spray. Accordingly, a complete house, the one with the most severe infestation of red spider, was sprayed using 1.5 pounds of the colloidal sulphur to 100 gallons of water. This spray was very effective and in a week was followed by another using 1.75 pounds of sulphur to 100 gallons of water. No injury resulted and four more sprays were applied at weekly intervals using a 2–100 spray.

After the second and third sprays spiders were scarce and mildew was almost absent. In the adjoining houses spiders were serious and mildew quite prevalent. This one season's experience indicates that red spider and powdery mildew on greenhouse cucumbers can be successfully controlled with hydrophilic colloidal sulphur spray. The strength of spray suggested for greenhouse cucumbers is 2 pounds of the sulphur paste to 100 gallons of water. This gave excellent control and has a wide margin of safety.

This is not the first use of hydrophilic colloidal sulphur spray as an acaricide. DeOng,[2] 1924, found it to be very effective against the red spider *Bryobia pratiosa*. He prepared his sulphur in the laboratory according to Young.[3] His results showed excellent control but he concludes hydrophilic colloidal sulphur would not replace lime sulphur, at least until a cheap method of manufacturing it was devised. The strength of sulphur suggested will cost about the same as lime sulphur and considerably less than nicotine sulphate.

L. J. ALEXANDER
H. C. YOUNG
OHIO AGRICULTURAL EXPERIMENT STATION,
WOOSTER, OHIO

PHAGOCYTOSIS OF BRUCELLA, AN INDEX OF IMMUNITY TO UNDULANT FEVER IN MAN

STUDIES of the phagocytic activity of the polymorphonuclear cells in the blood of man toward the genus *Brucella* have revealed an important relation between this phenomenon and susceptibility and immunity toward undulant fever.

It has been found that the cells of individuals who have never knowingly been in contact with *Brucella* infective materials or who have not had undulant fever, possess little if any phagocytic activity for the organism when mixed with it *in vitro*. The polymorphonuclear cells of those who have handled infective materials, such as cultures or infective tissues, and of those who have recovered from undulant fever have marked phagocytic activity. It has been found from the study of many such cases that from 80 to 100 per cent. of these particular cells will ingest *Brucella* to a marked degree.

During the course of the infection in man the phagocytic activity of the cells will vary. As a rule only slight, if any, phagocytosis will be seen. As recovery takes place, the phagocytic activity of the cells increases rapidly.

There appears to be no relationship between the agglutination titer of the serum and the phagocytic activity of the cells in the same individual. Phagocytosis may be negative when the serum shows a titer of 1 to 2,000, or 100 per cent. of the cells may show a marked phagocytosis when serum agglutinins cannot be demonstrated in a dilution of 1 to 25 or higher.

The phagocytic activity of the polymorphonuclear cells in individuals who have recovered from undulant fever appears to persist for a considerable period of time. These cells of one individual three years after recovery and several one year after recovery show a phagocytosis of 100 per cent.

The technic which we are using in this study is as follows: Blood is collected and mixed with sterile, two per cent. sodium citrate physiological salt solution. The blood cell suspension is added to a suspension of a strain of *Brucella* (turbidity 3 McFarland nephelometer) in the proportion of 1 to 1 and mixed well. The mixture is then placed in a 37° C. incubator for 30 minutes. At the end of this period, the cells are smeared on slides and stained with Hastings blood stain. On microscopic examination, 50 to 100 polymorphonuclear cells are examined. The cells are grouped according to whether they show a marked, moderate, slight or no ingestion of the bacteria.

---

[2] E. R. DeOng, "The preparation and use of colloidal sulphur as a control for red spider," *Jour. Econ. Ent.* 17: 533–538, 1924.

[3] H. C. Young, "The toxic property of sulphur," *Ann. Mo. Bot. Gard.* 9: 403–435, 1922.

A more detailed report of this study will appear in the *Journal of Infectious Diseases*.

I. Forrest Huddleson,
Howard W. Johnson

Central Brucella Station,
Bacteriological Section,
Michigan State Experiment Station

THE EFFECT OF TEMPERATURE ON THE NUMBER OF SCALES IN TROUT

It has long been known that fish from southern localities usually have a smaller number of scales than those of the same species from farther north, and it has been assumed that the decrease in the number of scales is due to the higher temperature under which the individuals develop. While some writers postulate a theory of selection of those individuals which are best constituted to meet the temperature conditions of the environment, others have proposed a direct effect on the integumentary system. As far as the writer is aware, no one has previously demonstrated from the experimental side that the number of scales can be directly modified by temperature. During the past summer an experiment was conducted on the eggs and alevins of Kamloops trout (Salmo kamloops) to determine the effect of temperature in this respect. The index chosen to specify the number of scales was a count of the number of oblique, parallel rows running in a downward and backward direction from the dorsum to the lateral line. The series begins just behind the head and ends at the termination of the vertebral column. Kamloops trout of Kootenay Lake were selected for the experiment. These trout have an average index of 145 rows with a standard deviation of about 6 rows, the total range is 130–160 rows. Eggs were obtained for the experiment on May 23 from fish at the end of the spawning run. Six pairs of trout were selected and the eggs of each pair were kept separate. The alevins and fry produced from these were reared in the hatchery at Nelson, B. C., under the ordinary hatchery temperatures. The water temperature in the hatchery begins to rise from the stationary winter level (1°–2° C.) at the end of February. It rises continuously until the end of July or the first week in August when it is 12°–13° C. The eggs from the end of the spawning run thus develop under warmer temperatures than the eggs from the earlier part of the run. The average index for each of the six lots of fry was in every case below the lower limit of the standard deviation for the normal population (below 139 rows). In each case the index of the offspring was significantly below the counts for their own parents. This part of the experiment indicated that the individuals having a low scale count in the normal population are probably produced from eggs which have been deposited at the end of the spawning run and have, consequently, developed at a higher temperature. In order to check this theory a random sample of eggs spawned during the middle of the run was removed from the hatchery on June 24 at the eyed-egg stage. These were reared at a temperature approximately 5 Centigrade degrees above that occurring in the hatchery until August 10, when the warmer temperature was discontinued. In these fry the average number of scale rows was reduced by 10 from the normal average for the population. A corroborative experiment was carried out with the eggs from one of the six pairs mentioned above. The eggs were divided into two lots.

Lot 1 was reared at ordinary temperatures. The resulting fry had a scale count of 132 rows on the average and were 13 rows below the normal population—16 rows below the female parent and 17 rows below the male.

Lot 2 was reared at the higher temperature, namely, 5 Centigrade degrees above normal. The resulting fry had an average scale count of 127 rows or 18 below the normal average and 21 and 22 rows below the female and male parent respectively.

From these experiments it seems evident that in Kamloops trout the number of scales is directly modified in an inverse manner by temperature, the higher the temperature, the fewer the scales. The data will be more fully presented and discussed in a forthcoming paper.

C. McC. Mottley

Pacific Biological Station,
Nanaimo, B. C.

BOOKS RECEIVED

British Museum of Natural History. *iptera of Patagonia and South Chile.* Part II, Fascicle 4: *Simuliidae*, by F. W. Edwards. *Ceratopogonidae*, by A. Ingram and J. W. S. Macfie. Pp. 121–232. 34 figures. The Museum. 5 shillings.

Brown, Lawrason and Fred H. Heise. *The Lungs and the Early Stages of Tuberculosis.* Pp. 151. Appleton. $1.50.

Department of Agriculture, University of Cambridge. *Farm Economics Branch Report Number 18. An Economic Survey of Hertfordshire Agriculture.* Pp. v + 104. Heffer, Cambridge. 2/6.

Dodge, Raymond and Eugen Kahn. *The Craving for Superiority.* Pp. vii + 69. Yale University Press. $1.50.

Rockefeller Institute for Medical Research. *History, Organization, Present Scope of the Scientific Work, Buildings and Equipment; Publications.* Pp. 36. Illustrated. The Institute.

Shapley, Harlow. *Sidereal Explorations.* Pp. 45–115. 25 figures. Rice Institute.

Shewhart, W. A. *Economic Control of Quality of Manufactured Product.* Pp. xiv + 501. 147 figures. Van Nostrand. $6.50.

Stromsten, Frank A., editor. *Mammalian Anatomy with Special Reference to the Cat*, by Alvin Davison. Fifth edition, revised. Pp. xiv + 311. 141 figures. Blakiston. $2.50.

Walters, Nelson F. *Inheritance of Body Weight in Domestic Fowl.* Pp. 105. 46 figures. Agricultural Experiment Station, Rhode Island State College.

SCIENCE

VOL 74 FRIDAY, OCTOBER 2, 1931 No 1918

British Association for the Advancement of Science
The Growth in Opportunities for Education and Research in Physics during the Past Fifty Years SIR J J THOMSON 317

Post Ehrlich Immunology DR. W H MANWARING 324

Obituary
David Starr Jordan DR BARTON WARREN EVERMANN *Memorials, Recent Deaths* 327

Scientific Events
The International Illumination Congress, Committee Appointments of the American Institute of Electrical Engineers, Wild Life in National Forests, The New Agricultural Engineering Building at the University of Kentucky, The Publication of Newton's Correspondence 330

Scientific Notes and News 333

Discussion
The Megagametophyte of Pinus PROFESSOR W H EMIG *Pauropoda in Alaska* DR. WILLIAM A HILTON *More about Citations* BERNARD H LANE *Vision, and Vascularity of the Eye* E M JOSEPHSON 337

Scientific Apparatus and Laboratory Methods
Absorption Devices and Methods DR. JOHN W WILLIAMS *Double Plate Method Used for Culturing Tilletia Levis* PROFESSOR E W BODINE 340

Special Articles
Inbreeding in Alfalfa Establishes a High Degree of Homozygosity DR GEORGE STEWART *Non-Acid Fast Tubercle Bacilli* DR FRANKLIN R MILLER 341

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE GROWTH IN OPPORTUNITIES FOR EDUCATION AND RESEARCH IN PHYSICS DURING THE PAST FIFTY YEARS[1]

By Sir J J THOMSON

HONORABLE PROFESSOR OF PHYSICS, THE UNIVERSITY OF CAMBRIDGE AND THE ROYAL INSTITUTION, LONDON

DURING the last year we have lost by the death of Professor Albert Michelson a physicist whose work was of quite exceptional importance The famous experiment known everywhere as the Michelson-Morley experiment has, since it is the basis of the theory of relativity, been largely responsible for the trend of physical thought during the present century. It is a very striking example of the great philosophical consequences which can result from what might seem the rather mechanical process of improving the precision of physical measurements, the importance of the experiment depended entirely on the accuracy of the measurements being great enough to detect with certainty changes amounting only to one part in a hundred million

The additions to our knowledge of physical phenomena and the number of new ideas introduced into physics since the last anniversary meeting have been so great and cover such a wide range that it would be impossible in the time at our disposal to give an account of them which would be at all adequate or even intelligible to those not already acquainted with them There are, however, advances of another kind of great importance to the progress of physics which lend themselves more readily to a less inadequate treatment in such an address as this Such advances are the increase in the opportunities for teaching and research in physics caused by the foundation of many new laboratories, the increase in the attention paid to the teaching of physics in our schools, the endowment of research workers and the increase in the opportunities for these to obtain remunerative employment, the increased recognition of the importance of research in industry and last but not least the improvements made in instruments used in research and the increase in the magnitude of the forces, mechanical, electric and magnetic, which are now at our disposal The physical laboratories in the eighteenth century and the first half of the nineteenth were in the main collections of instruments suitable for experiments to illustrate the lectures of the professor, and the trouble taken over these experiments was, I think, comparable with that taken now Thus, Wollaston, who was Jacksonian professor at Cambridge at the end of the eighteenth century, is said to have shown over 300 experiments in his annual course of lectures and at a later period Stokes, in his lectures on optics, showed experiments which have not been excelled, for beauty, for educational value, for simplicity or for certainty

---

[1] Address of the president of Section A—Mathematical and Physical Sciences, British Association for the Advancement of Science, London, September, 1931.

In spite of the fact that until the end of the last century there were but few laboratories available for research much scientific work of the highest importance was accomplished This, to a very great extent, was due to men who made their own laboratories and bore themselves the cost of the experiments Thus, Joule made his experiments on the mechanical equivalent of heat in his house at Manchester, Stokes, like Newton, made fundamental experiments on optics in his college rooms, Spottiswoode, Huggins, De la Rue, Lord Rayleigh, and one who has had a long and intimate connection with the British Association—Dr E H Griffiths—also made in their own laboratories and at their own charges additions of great value to physical science.

These men, like Kelvin and Maxwell, had not passed through any course of instruction in practical physics, for no such courses were available, they were in this respect self-taught Most of them had learned how to use their hands by having had when young some hobby, such as using a lathe, or dabbling in chemical experiments or photography This training seems to have been effective, for no one can say that their work is amateurish This raises the important question, may not the present practice in which our advanced students spend a great deal of time in acquiring dexterity in the use of instruments of all kinds be a wasteful one, and could not the student who has learned how to use his hands, has a good knowledge of physics and some practice in making accurate measurements, be trusted to master in a short time the technique of any instrument he might require in a special investigation?

In the early seventies when I first began to study physics at Owens College, Manchester, there were only six physical laboratories in England—the Royal Institution, the Clarendon Laboratory at Oxford, those at University and King's Colleges and the one at the Royal School of Mines in London and one at Owens College, Manchester; there were four in Scotland, one in Ireland and none in Wales Now the number of physical laboratories at the universities, university colleges, schools, and institutes of technology at which instruction is given in physics, is considerably more than 300 Nearly the whole of this increase has occurred since our last anniversary meeting The contrast between then and now would be even more marked if we took into account the size of the buildings Some of the laboratories in those early days were very small affairs Professor Ayrton described Sir William Thomson's laboratory at Glasgow as consisting at one time of one room and an adjacent coal cellar When I was at Owens College, Manchester, though it was one of the first places where instruction was given in practical physics, there was no separate laboratory, but only a few rooms and little apparatus Though the laboratory was small, it was large enough for the few students who worked there, and these had much more freedom and more initiative than would be possible with the large number of students that have now to be provided for We were allowed to choose our own experiments, we fitted up the experiments for ourselves and if they did not work we tried again, we were not limited with respect to time and we could follow up any point of interest we happened to come across This rather happy-go-lucky method would be quite impossible with large classes, but it was more interesting and, I think, a better training for research than the highly organized classes which large numbers necessitate At any rate, I am glad that I came under the old and not under the new system The new method, however, besides being inevitable has some very decided advantages There are students who are quite immune when in the lecture room to infection from any physical idea and only get a grip of physical principles when these come before them in the concrete form of an experiment which they make with their own hands; these men learn their theoretical as well as their practical physics in the laboratory, and the nature of the experiments, their number and their sequence are of first-rate importance, all this requires a great deal of organization

SCIENCE TEACHING IN SCHOOLS AND UNIVERSITIES

The movement for including science among the studies pursued in our universities and schools was born almost at the same time as the British Association and the men who took the most prominent part in it, Adam Sedgwick, Herschel and, above all, Whewell, were closely connected with the association. It was some time before the movement led to definite results, but in 1849 the University of Cambridge determined to establish a natural sciences tripos. It was not at first an avenue to a degree and the subjects teachers at the university should regard research mainly from the point of view of its value as an educational training and not as a means of getting within the year as many new scientific results as possible The student should be encouraged to overcome his difficulties by his own efforts and the assistance given by the teacher should not be more than is necessary to keep him from being disheartened by failure and to prevent the work from getting on lines which can not lead to success

I should like to emphasize the last part of this quotation A year or two spent on research under proper conditions is an educational training which can not easily be overrated, but under others it may be positively harmful It must always be borne in mind that the primary object of a university laboratory is not the same as that of a laboratory where there are no students in training, such as the National Physical Laboratory or the laboratory of a great firm In such laboratories the main object is to get results, to discover as many new facts as possible In a university laboratory the most important thing is to produce well-trained and well-educated men rather than to turn out the largest number of small papers To get scientific results rapidly, the best plan is for the staff to select the subject for investigation, to determine the kind of experiment to be made, to exercise daily supervision over the work and to leave to the student little besides the taking of the observations The intellectual development of the student is injured rather than benefited by a training like this You can not without disaster apply methods of mass production to education Even in university laboratories where the importance of affording mental training is fully realized, over-specialization is the great danger of these courses of research and one that requires much care to avoid The student gets so engrossed in his experiments that he grudges the time spent on going to lectures or on reading books which are not on his own special subjects He often spends too much time in making the experiments and too little in thinking about them Sometimes, too, he neglects to take advantage of the opportunities afforded by a resident university for social intercourse with men of all shades of opinion and of experience There is danger, too, of his getting into a groove and to go on working for the rest of his life on the particular subject on which he was first engaged.

I think it helps one to get new ideas if the mind does not dwell too long on one subject without interruption and if every now and then the thread of one's thought is broken. It is, I think, a general experience that new ideas about a subject come when one is not thinking about it. I am not a psychologist and do not know the views held as to how new ideas originate, but to my mind there is considerable practical analogy between this process and one about which we have been hearing a good deal during the last few days, the induction of currents in a magnetic field For this to occur change as well as the magnetic field is necessary If a circuit is in such a field nothing happens as long as it is in repose, but if you disturb this repose, currents begin to flow through it Now compare the circuit to the brain, the magnetic field to the state produced in the brain by long thought about a subject, the starting of a current to the starting of an idea No ideas will come as long as the brain remains in the same condition without any change in its point of view, but if this changes, then currents or ideas are produced in the brain, the change as it were strikes sparks in the brain This is one reason why I think it is desirable that the student should do a little teaching, another is that it would give him experience which may be valuable in afterlife and help him to obtain a post

CAREERS AND RESEARCH WORKERS

I now come to the subject of the careers open to men who have had a training in research Sixty years ago the only posts open to these were teaching posts in the few physical laboratories then in existence The number of such posts increased very rapidly towards the end of the last century, as did also the demand for science masters for the schools, but until then and indeed for some time after it may be said that roughly speaking the only posts open to research workers were posts associated with teaching At the beginning of this century, however, the importance of research to our industries began to be realized The most striking instance of this is the establishment, in 1901, of the National Physical Laboratory for research both in pure science and in subjects which have an immediate application to industry The growth of this under Sir Richard Glazebrook and Sir Joseph Petavel has been phenomenal, there are now about 160 research workers employed in the laboratory and the budget has increased twenty-fold Other methods of linking up science with industry are also being employed in this country Probably the most efficient is for a firm to have its own laboratory where its own problems can be investigated, in this case the inducements for success are greatest and knowledge of the technique and processes involved most accessible.

There are several such laboratories, each with a large staff in this country They are, however, so expensive as to be beyond the reach of any but very large firms. To extend the benefit of research to the industries generally, the Department of Scientific and Industrial Research was started by the government in 1915. At the instigation and with the aid of grants from the department, the members of various industries have combined and formed research associations with laboratories suitably equipped for research in matters relating to the particular industry There are now more than twenty of these associations They have had to contend with many difficulties, at first there was plenty of money but no well-trained men, now there are plenty of men but no money There are, however, good reasons for thinking that in spite of these difficulties the financial gain to the industries has far exceeded the expenses of the laboratories. In addition to granting aid to these associations, the department has established boards for research in matters which concern all industries There is the Fuel Research Board, which deals with problems vital to the country on the production of power from coal and other fuels, there is a Food Research Board, for research on the storage and transport of food, there are boards for building, forest products, radio and chemical research All these have laboratories and staffs of research workers, as have also the research departments of the army, navy and air services.

I have tried to find how many workers are employed in these applications of science to industry, but have not been able to get any estimate which would be of any value, one great difficulty is to draw the line between posts which seem adequate for those who have gone through a long and expensive training in research and those which do not One thing, however, can be said, that the demand we have had in Cambridge for workers trained in research has, until this year of acute and long-continued depression, exceeded the supply, and although it is possible to have overproduction in research workers, we do not at present seem to have reached that stage for normal times

In considering research as a profession, it must be remembered that especially in research of a pioneering kind the worker may spend years without getting results of any very striking importance He may get depressed, lose hope and be inclined if he gets the chance to go into administration and organization where there is a greater certainty of work yielding an adequate result. The researcher, if he is to have a happy life, must regard the game and not the score as the chief thing In every research difficulties and apparently anomalous results are constantly turning up To overcome these, to make clear and consistent what before was obscure and confused, is to some minds one of the keenest of pleasures and one which may be produced by discovering the source of a persistent leak in a discharge tube just as well as by finding a new ray. Experience shows that men with minds of this type are not very common There are many who when they are young and just fresh from a laboratory, where there is an atmosphere of research and many research workers, are so enthusiastic about research that they think nothing else matters. Often, however, this enthusiasm soon fades and they become more interested in organization and administration than research Thus, those who begin by working in the research department of a firm tend to drift into the other departments I think this, on the whole, is an advantage, for it diffuses the scientific spirit and outlook throughout the work of the firm; this may be as important as discoveries in the laboratory and quicker in its effects.

The increase in the number of research workers has naturally led to a corresponding increase in the number of papers on physics. From one point of view this is very gratifying, from another it is embarrassing. *Science Abstracts* for 1930 contains abstracts of 4,165 papers on physics, corresponding to very nearly a dozen a day It is obvious that no one can read more than a small fraction of these. It is generally more than one can do to read even those in a particular branch of physics, this leads to great specialization Volumes such as those of *Science Abstracts*, which give the gist of a paper in a small space, are of great value, especially for looking up the literature of a subject over a definite period For this purpose, however, the subject index is of vital importance, in making this index it is not enough to go by the title of a paper, the contents of a paper can not all be got into its title. The makers of the index should have read the papers. This seems a council of perfection, but it would practically be secured if the maker of the abstract were to send in with it cards for the subject index This is work that requires great care and sound judgment.

I do not think that abstracts alone are sufficient to cope with this avalanche of papers on physics. As far as I know we have nothing in physics corresponding to the annual reports issued by the Chemical Society on the progress of various branches of chemistry. I think it would be a very good thing if we had, and that it is a thing on which money and time might well be spent In addition to these, there should, I think, be fuller and more critical reports issued regularly at a longer period, say quinquennially, of the character of those which from time to time have been published by the British Association and by the National Academy of Washington. Another minor suggestion is the publication each month of the titles (without any abstracts) of the physical papers published in scientific periodicals and the proceedings of scientific societies during the preceding month. This used to be a feature of *Wiedemann's Beiblätter* and I found it very useful.

In addition to the advances we have been considering, the instruments and appliances in laboratories are very much better and more convenient than they used to be. The most vivid impression I have of my early work in the laboratory is that of Grove's cells, these had platinum foil immersed in nitric acid for one electrode, zinc in dilute sulphuric for the other, and what with the fumes which assailed one's throat and the acid which destroyed one's clothes, the assemblage of a battery of cells was a most disagreeable business. I have not seen a Grove's cell for forty years and do not want to see another. Now instead of making up a battery we just put a plug into a hole. Another instrument which was exasperating to work with was the old quadrant electrometer, this not infrequently refused to hold its charge and neither prayers nor imprecations would induce it to do so, it has, fortunately, been replaced by more sensitive and convenient instruments. With regard to galvanometers, I have the authority of Mr. Whipple in saying that one suitably selected for the purpose for which it is required may be at least ten thousand times more efficient than the instruments available fifty or sixty years ago. The extensive use of electrical instruments in connection with electrical lighting and engineering has caused a great deal of attention to be paid to their design with the result that they are far more convenient and reliable than they used to be. The improvement of instruments is of first rate importance for the progress of physics, a considerable increase in the efficiency of an instrument may open up a new region of physical phenomena. The most striking example of this is the effect produced by improvements in the methods of producing high vacua. Roughly speaking, we may say that modern physics depends on our power of studying individual atoms and electrons and not merely large crowds of these particles. To do this, one atom must not be hit by another while under observation, as it would make more than ten thousand collisions in a centimeter if the pressure were atmospheric, a very high vacuum is required. Until early in this century this had to be got by Sprengel pumps, which involved one raising and lowering a vessel filled with mercury for hours on end and getting what would now be considered a very poor result, but a vivid appreciation of the intensity with which nature abhors a vacuum. All this was changed after Sir James Dewar introduced the method of producing high vacua by means of charcoal cooled by liquid air. This was not only much more rapid and convenient but produced very much higher vacua and made it possible to make experiments and measurements which could not have been made before the introduction of this method and which have revolutionized our ideas of the structure of matter. If science helps the industries they in return help science. An illustration is that the need of a high vacuum for hot wire valves and electric lamps made its production a matter of commercial importance with the result that the physicist has now at his command pumps so powerful that they can maintain an exceedingly high vacuum in spite of the influx into the vessel of a stream of the particles we wish to study, this is exceedingly important when investigating charged atoms and electrons.

The hot wire valve is another instrument which has greatly helped research in physics, the immense magnification of weak effects which can be produced by it enables us to detect with certainty phenomena which before its introduction were almost beyond our ken. Those who like myself repeated, more than forty years ago, Hertz's experiments will contrast the difficulty we had in detecting electrical waves even when the source was only a few yards away with the ease with which modern methods using hot wire valves detect waves which have traveled thousands of miles.

I have alluded to advances in the efficiency of the instruments. There is another advance in them which is not so gratifying, that is the advance in price. The cost of research in physics is much greater than it used to be. Before the war when about thirty research students were working at the Cavendish Laboratory, the cost of their researches was about £300 per annum. Now it would be at least five times that amount. To balance this there are now far greater sums available for research than there were in those days.

I have in this address confined myself to what may be called the machinery of research in physics. I will now say a word or two about another point. The additions to our knowledge of physical phenomena and to physical conceptions made in the last sixty years have not been excelled by those made in any period of the history of the science, and yet I remember that at the beginning of this period the view was prevalent that all the fundamental principles of physics had been discovered and that the work of the future would be to develop and coordinate those principles and to measure more and more accurately the value of known physical constants. This view seems ludicrous when we know that within a few years Röntgen rays, the electron and radio-activity were discovered. The existence of these was quite unexpected, and no hint of the possibility of their existence was given by any of the physical theories then extant; this view was, however, to my knowledge, held by some eminent physicists. The great generalizations expressed by the first and second laws of thermodynamics loomed so large in those days that it was thought that nothing was beyond their purview This state of mind is apt to occur after a great discovery, it occurred after that of universal gravitation, there are signs that it exists now Yet it has always been falsified by experience, and I think always will be There are no signs that physics is approaching an asymptotic state in which the progress gets slower and slower as time goes on The additions to our knowledge of physics made by our generation do not get smaller and smaller as one generation succeeds another, each great discovery is not a terminus but an avenue leading to new knowledge An improvement in technique may, as we have seen, lead to fundamental changes in our views of the nature of matter and of physical processes There is far more in physics than is dreamt of in our theories, and nature herself, if we observe her carefully, is more suggestive of ideas than the minds of the most imaginative of us The ideas which revolutionize science are just those of which our theories give no indications Theories are the very life-blood of physics Most of the researches in our laboratories originate in an attempt to test a theory, theory, however, may be injurious if it makes us concentrate our attention exclusively on the particular problem it suggested and to treat as an annoyance, to be avoided by a change in method, any anomaly in the experiment which interferes with our progress to the goal, the anomaly may be the outcrop of a vein rich in new phenomena After Rontgen had discovered x-rays, another physicist who had been working with somewhat similar apparatus said that he had noticed that any photographic plates near his tube got fogged and spoiled, he moved his plates further away and left it at that The discovery of argon by Lord Rayleigh arose from some vexatious discrepancies in a series of weighings

I do not think that there is any danger of the supply of new physical phenomena being exhausted and of physicists joining the ranks of the unemployed Rather do I believe that as each successive centenary comes round the president of section A will be able to say that the growth of physics in the century which has just passed is comparable with that in any of its predecessors

POST-EHRLICH IMMUNOLOGY[1]

By Dr W H MANWARING
STANFORD UNIVERSITY, CALIFORNIA

FROM a philosophical point of view, classical immunology was equivalent to the postulate that pathogenic microorganisms and the animal body are each vitalized by a unit force, purpose, plan or will that transcends ordinary biochemical laws Thus supermaterially stabilized, test-tube microorganisms are biochemically identical with the specific infections from which they were isolated and each and every specific serum change in convalescence and artificial immunization is a purposeful defensive hormone Since this supermaterial somatic organization is immutable in its plan and purpose, it follows that a minute sample of each and every specific serum component that can be formed in the animal body is preexistent in its hereditary tissues, together with a physiological mechanism for its emergency increase in times of specific need This is but a restatement of the specific receptor hypothesis in non-conventional language

LOSS OF FAITH IN CLASSICAL THEORY

Recognizing the theological origin of this implied vitalistic theory, and its basic rôle in practical immunology and research, many attempts have been made toward its experimental verification or disproof Expressed in conventional language, inquiry has been made as to whether or not clinicians are justified in assuming that each and every convalescent serum component is preexistent in normal animal tissues, and whether or not each specific convalescent serum property is a purposeful defensive hormone

To technical specialists probably the most convincing evidence against this ancestral logic is Otto's alleged separation of "specific sensitizin" from "specific precipitin" by electroosmotic methods This separation proves that these two convalescent serum components are not chemically identical, and, therefore, can not be mere quantitative variations of the same hereditary defensive hormone[2] To non-specialists equally suggestive evidence is contained in the war-time researches of Ostromyschlenski and Petroff. These two Russian biochemists incubated mixtures of diphtheria toxin and normal horse serum and found that among the numerous resulting chemical products there are certain denatured serum colloids apparently identical with diphtheria antitoxin[3] Such test-tube synthesis would be inconceivable, if diphtheria antitoxin can be formed only as an internal secretion from fixed tissues Subsequent immunochemists have reported similar test-tube syntheses of specific precipitins, agglutinins and bacteriolysins[4]

---

[1] Presented before the Society of American Bacteriologists, Pasadena, California, June 18, 1931

[2] R. Otto and T Shirakawa, *Ztschr f Hyg u. Infektionskrankh*, 103, 426, 1924

[3] Ostromyschlenski and Petroff, *Rus Gesell. f. physical Chemie*, 47, 263, 1915 (This work was not brought to the attention of international medical science till 1925, and not confirmed in Russian laboratories till 1929, when Kryshanowski prepared several variants of the Ostromy-

Accumulating evidence of this type has justified the post-Ehrlich denial that each and every convalescent serum change is a desquamated preexistent normal cellular component[5] and has led to the current belief that there are normally present in the animal body enzymic, hormonal and genetic factors capable of synthesizing new or previously non-existent protective specificities[5,6,7]

Since antitoxins, precipitins, agglutinins, opsonins and other so-called "antibodies" are known or assumed to be specialized proteins, post-Ehrlich immunology assumes that, as a result of natural infection or artificial immunization, new, previously nonexistent protein specificities are synthesized, "induced" or "grafted onto" the animal body, and that some of these exogenous or endogenous "mutant" proteins are specifically defensive in character This, of course, does not exclude the probability that there are numerous relatively inert "mutant" specificities, and even "induced" specificities injurious to the body

RECENT ADVANCES IN PROTEIN PHYSIOLOGY

In approaching problems suggested by this current denial of super-material stabilization and motivation of animal tissues, post-Ehrlich immunologists have to their advantage numerous facts not known to earlier theorists Probably the most significant of these facts are the recent hints as to the probable nature for protein specificity Within the last five years, artificial conjugation of a protein molecule with a single amino-acid, lipoid or polysaccharide has been shown to confer upon it a new immunological specificity, the "ongrafted" or "induced" character being to a large extent independent of the nature of its protein carrier By absorption methods, the conjugated amino-acid, lipoid or polysaccharide can be diagnosed, irrespective of this carrier[8] The conjugated group may even dominate immunological specificity, egg albumin, for example, conjugated with the complex polysaccharide recently isolated from typed pneumococci, being successful vaccine against experimental pneumococcus infection in rabbits[9]

Protein specificity, therefore, is no longer regarded as a test of complete protein individuality It is apparently a composite picture of superficial colloidal "determinants," protein characteristics differing from the composite protein pattern of the animal used for the test. Human proteins, for example, may well be 99 per cent identical with rabbit proteins, the rabbit precipitin being merely a test for the 1 per cent human characteristic Two proteins giving the same serological reaction are no longer necessarily identical nor are identities revealed by sera or anaphylactic tests with one animal species necessarily the same as relationships revealed by different animal tests Serological classification of animal and plant proteins is but a classification relative to the animal species selected for the production of the diagnostic antiserum

Equally significant are the new views as to the probable interrelationship of normal serum colloids. An intravascular conversion of serum albumin into serum globulin is now known to take place, with postulated orderly intravascular syntheses from the simplest nitrogenous compound to the most complex serum colloid Antigens, therefore, are no longer injected into a static colloidal environment, but into a dynamic protein mixture, with a hundred orderly syntheses and disintegrations, conjugations and dissociations that may conceivably modify their chemical properties[10]

Older immunologists assumed that absorption of undigested food proteins does not take place through the normal gastro-intestinal mucosa, any apparent absorption being *ipso facto* pathological Within the last three years, however, it has been definitely proved that gastro-intestinal absorption of undigested food proteins is a normal physiological process[11,12,13] and that alien protein absorption also takes place through other mucous surfaces[14,15] The normal animal of current immunology is no longer a specific immunological zero, but an animal with a dozen constantly exercised antiprotein functions, a hundred well-developed tolerances or immunities, with the probability that many of these physiological tolerances are directed against minor characteristics of any natural infection or injection antigen

---

schlenski artificial diphtheria antitoxin. *Centralb f Bakt.*, 110, 1, 1929)

[4] For bibliography see *Jour Immunol*, 19, 155, 1930

[5] W H Manwaring, *Jour. Immunol*, 12, 177, 1926, 19, 155, 1930 (See also, Jordan and Falk, "The New Knowledge of Bacteriology and Immunology," Chap 81, p. 1,078, 1928)

[6] A. Locke, E R. Main and E F. Hirsch, *Arch Path*, 2, 437, 1926.

[7] G. Ramon, *Compt rend. Soc biol*, 102, 381, 1929

[8] K. Landsteiner and J. van der Scheer, *Jour. Exper. Med.*, 48, 315, 1929, 50, 407, 1929

[9] O T Avery and W F Goebel, *Jour Exper. Med.*, 50, 533, 1929

[10] J L. Azevedo, *Proc Soc Exper Biol and Med*, 27, 4, 1929

[11] M. Walzer, *Jour Immunol*, 14, 143, 1927

[12] H H Donnally, *Jour Immunol*, 19, 15, 1930

[13] A Cocoa, *Jour Immunol*, 19, 405, 1930

[14] J Finder, A F Lash and J Simons, *Proc Soc Exper Biol. and Med*, 27, 368, 1930.

[15] M. B Cohen, E E. Ecker and J B Breithart, *Jour Immunol.*, 18, 419, 1930.

DYNAMIC PROTEIN SPECIFICITY

Classical physiology assumed that the human body is static in its protein specificity To maintain this stasis it was endowed with a 100 per cent efficient alien protein excretory function in the kidneys, and a 100 per cent. efficient alien protein destructive function in internal tissues. Current immunology challenges both assumptions For example, in the albuminurea following excessive protein diet, the urine has been shown to be free from food proteins, apparently containing only normal serum albumins and normal serum globulins, presumably escaping as a result of increased glomerular permeability[16] Parenteral hydrolysis of alien proteins would be hard to conceive without postulating a multiplicity of highly specialized enzymes, beyond the range of present biochemical knowledge

There is both direct and indirect experimental evidence that such automatic tissue purification does not take place It has long been known, for example, that alien proteins injected intravenously into rabbits can not be detected in rabbit tissues later than the fourth day by the ordinary precipitin or anaphylactic tests[17] This is far from being proof of their quantitative destruction or elimination, however, since a slight change in one or more surface characteristics might conceivably alter the specificity of the injected proteins and thus account for their apparent disappearance That this is the probable fate of certain alien proteins is shown by injecting horse serum intravenously into dogs and studying its possible retention with specific rabbit precipitin. By the end of six days, the alien serum proteins are so far denatured as to be wholly non-antigenic for dogs, while still retaining part of their original horse protein specificity for rabbits[18,19] The concentration of these retained, partially "caninized" horse proteins decreases to about 10 per cent by the end of three months, but with quantitative curves from which their mathematically complete elimination or destruction can not be predicted during the lifetime of the animal[20]

Indirect evidence in support of such parenteral denaturization and retention may be drawn from recent studies of the so-called "serological ripening" or "physiological maturation," the apparently spontaneous appearances of new serum specificities during adolescence[21] in both man and laboratory animals[22] So marked is this change in rabbits that old-age rabbit serum injected into younger rabbits is alleged to stimulate the formation of specific precipitins for old-age rabbit proteins[23] Such new specificities prove retention or environmentally "induced" new specificities, unless one is prepared to postulate a phylogenetic recapitulation of ancestral protein specificities not complete till late adult life[24]

That such "engrafting" or "induction" of new specificities is a biological possibility is proved by recent studies of "induced" or "mutant" bacterial specificities, a mixed culture of colon bacilli and dysentery bacilli, for example, with dysentery specificity "grafted" onto the colon bacilli, and persisting for at least seven test-tube generations after separation of the two microorganisms.[25] Probably a more convincing example is the alleged "induction" of diphtheria specificity in associated streptococci, the quasi-diphtheria characteristic persisting for at least twelve test-tube generations after separation of the two microorganisms[25] Experimentally induced new specificities are also reported in erythrocytes[26]

The so-called "bacteriophage" furnishes another suggestion example In time "bacteriophage" may be pictured as a dissociated protein pervert or a dissociated "mutant gene," of slightly different specificity from the parent microorganism[27] This "mutant" protein is apparently incapable of self-multiplication, but multiplies or is multiplied when absorbed into active symbiosis with intact bacteria[28] Thus multiplying, it eventually perverts microbic specificity, thus functioning as a lethal factor For half a century, geneticists have speculated on such possibilities.

PRACTICAL APPLICATIONS

One of the major puzzles of the last two decades has been the numerous inconsistencies and irreconcilabilities in "anaphylaxis" and immunity.[29] To the newer immunology "sensitivity" is due to accelerated humoral and cellular reactivity, with no preconception as to whether or not such acceleration acts to the specific advantage or disadvantage of the individual[30,31,32]

---

[16] H G Wells, *J A M A*, 53, 863, 1909

[17] R M Pearce, *Jour Exper Med*, 16, 349, 1912

[18] W H Manwaring, H D Marino, T C McCleave and T H Boone, *Jour Immunol*, 13, 357, 1927.

[19] W H Manwaring, H D Marino and J L Azevedo, *Jour Immunol*, 15, 109, 1928

[20] H C Sox and W H Manwaring, *Jour Immunol.* (in press).

[21] E Friedberger, G. Bock and A Furstenheim, *Ztschr f. Immunitätsforsch*, 68, 480, 1930.

[22] E Friedberger and D Gajzago *Ztschr f Immunitätsforsch*, 67, 67, 1930.

[23] T C Picado, *Compt rend. Soc biol*, 102, 631, 1929.

[24] Editorial, *J A M A*, 96, 950, 1931

[25] G W Wygodtschikoff and N. S Mannilowa, *Ztschr f Immunitätsforsch.*, 68, 480, 1930.

[26] C. Hallauer, *Ztschr f Immunitätsforsch.*, 67, 15, 1930

[27] C W. Jungeblut and E. W. Schultz, *Jour. Exper. Med.*, 69, 127, 1929

[28] A. P. Krueger and J H. Northrop, *J. Gen. Physiol.*, 14, 223, 1930

[29] A. R. Rich, *Arch Path*, 7, 552, 1929.

[30] W. H. Manwaring, H. D Marino, T. C. McCleave and T. H. Boone, *Jour. Immunol.*, 13, 357, 1927.

[31] W. H Manwaring, H. D Marino, J. L. Azevedo and H. C. Torbet, *Jour. Immunol.*, 15, 351, 1928.

While classical vaccine therapy and serum therapy were justly proud of their few spectacular victories, they were humiliated by wholly illogical and much more numerous clinical failures. To post-Ehrlich immunology, test-tube "mutants" are not necessarily specific immunizing agents against corresponding infections, nor are serum "antibodies" in the horse necessarily directed against the antigenic "determinants," pathogenic for man.

Recent studies have shown that pathogenic microorganisms not only multiply in the corresponding specific immune serum but often multiply much more rapidly than in control tubes with normal serum.[33] A specific growth-stimulating bacterial retention product in convalescent animals is no paradox to modern theorists.

Recent tests have shown that tuberculous animals are not only resistant to superinfection with tubercle bacilli, but are apparently equally resistant to influenza, anthrax, streptococci and diphtheria toxin.[34] If in time it should be shown that there is no appreciable specific protective factor in tuberculosis, that the increased resistance to superinfection is largely nonspecific, it will be no surprise to current theorists.

Classical immunology is to-day puzzled by the apparently spontaneous appearance of diphtheria immunity in adolescent Eskimo children in an environment demonstrably free from diphtheria bacilli.[35] Post-Ehrlich immunology is prepared to consider a phylogenetic recapitulation of ancestral immunity not necessitating personal contact with specific infections.[36]

SUMMARY

Future bacteriologists can not assume without convincing experimental evidence that any pathogenic microorganism is necessarily static in its biochemical specificity, but must consider the possibility that immunochemical specificity varies with test-tube conditions, animal species, organ or tissue infected and stage of infection.

Future serologists can not assume without convincing experimental evidence that any specific serum component or property is necessarily a specific "antibody" or "defensive hormone", but must consider the possibility of a wide range of "engrafted," "induced" or "mutant" specificities, with no preconception as to their probable immunological rôle.

Future immunologists can not assume that the formation or "induction" of new protein specificities is the only important adaptive factor in specific immunization, but must emphasize the relative importance of collateral hypertrophies of non-specific enzymic, hormonal and genetic factors.

Finally, future clinicians must be cautious in endorsing any infectious theory which assumes or implies that the animal body is static in its biochemical specificity, but must be receptive of the accumulating evidence that specificity varies in different tissues, organs and body fluids, and at different stages of anatomical and physiological growth.

OBITUARY

DAVID STARR JORDAN

DAVID STARR JORDAN was born on a farm near Gainesville, Wyoming County, New York, on January 19, 1851. He died at his home, Serra House, on the campus, Stanford University, California, at 9 45 o'clock on Saturday morning, September 19, 1931, at the ripe age of 80 years and eight months.

On July 3, 1929, Dr. Jordan became very seriously ill, due in large part to the unusual extreme heat which prevailed during the first few days of that month at Stanford. For some time he was confined to his bed and his life was despaired of, but, in spite of renewed attacks, he recovered from each to some extent, but never quite fully; each relapse left him a little weaker than before. During these periods of partial recovery he was able to be taken in a wheelchair out into his flower garden, where he would remain some time each day in comfort in the pleasant surroundings. On one or two occasions he was taken to the quadrangle and to various places about the campus so familiar to him during his long connection with the university. The last of these little visits to old familiar scenes was only a few days before the end came.

Until toward the last he retained his interest in world affairs, and in certain ichthyological studies upon which he was engaged when first stricken. His last considerable contribution to ichthyological literature is a "Check-List of the Fishes of North and Middle America," a volume of 670 pages, the manuscript of which was finished only shortly before what he jokingly referred to as his "unceremonious collapse." He was pleased when the "Check-List" appeared in print (February 8, 1930), and he autographed three copies on March 27.

I first met Dr. Jordan in the spring of 1877 at

---

[32] A. Besredka, "Le choc anaphylactique," Masson et Cie, Paris, 1930, Chap. 7, p. 263, *et seq.*

[33] M. Nicolle and E. Cesari, *Annal. d. Inst. Pasteur*, 40, 42, 1926.

[34] T. Hirayama, *Ztschr. f. Immunitätsforsch.*, 68, 218, 1930.

[35] Bay-Smith, *Klin. Wochenschr.*, 21, 947, 1929.

[36] Editorial, *J. A. M. A.*, 96, 950, 1931.

Butler University, where he then was professor of biology The next year I was one of a dozen students led by Professor Jordan on a walking trip of 550 miles through the South—from Somerset, Kentucky, across Kentucky, Tennessee and North Carolina, into northern Georgia This was, in fact, a traveling school Dr Jordan had been through that country before and, being quite familiar with it, he gave us at least one lecture each day on the geology, natural history or political history of the region through which we were passing

That tramp through the South with Dr Jordan was the most important influence that ever came into my life I came to know him intimately and from many angles, and my admiration for his scholarly attainments and for him as a man grew day by day I then and there determined to continue as a student of his so that I might get as much from his inspiring teaching as possible That I did, and the association and the personal friendship begun then continued without interruption and without a single jar to the end, I always as his humble and enthusiastic helper, proud of his friendship and grateful for his patience and encouragement

Dr Jordan was, first of all, a naturalist His intimate knowledge of many species of animals and plants, gained through observation and study in the field of many individual animals and plants themselves, was marvelous In the making of a naturalist and the study of systematic zoology and botany, he regarded books as of value but as of only secondary importance He often said (quoting Agassiz) "when one studies Nature from books alone, he will not know her when he meets her in the woods or fields" He was amused by the discussion of evolution and the origin of species, in the papers at the time of the Scopes trial He felt that the only way in which species can be studied understandingly is through a careful examination and comparison of numerous specimens of different and related species Reading books about animals and plants can not alone give any clear conception of what a species is And one can not very clearly understand what is meant by the organic evolution of species unless he compares many specimens of closely related species Books about animals can not lead, a study of the animals themselves must come first Dr Jordan was a real naturalist He knew the animals and plants of the old farm on which he was brought up, and those of every region in which he later lived, not only the fishes (his first and abiding interest), but the birds, mammals, reptiles, amphibians, mollusks, crustaceans, lichens and the algae not only of the fresh waters and damp places but of the sea as well.

Dr. Jordan was a great teacher, great, whether the subject be geology, botany, entomology, invertebrate marine zoology, ornithology, ichthyology, general biology or evolution, or the languages, as German, French or Norwegian, for he, at times, had classes in every one of these subjects—and I was in most of them In the laboratory, after a few general directions, he usually left the student to his own resources, only asking him a few questions now and then, and checking up on his work He would very early assign some particular problem to the student If the student showed any special ability, Dr Jordan would suggest that he prepare a paper on the subject for publication Frequently he would ask the student to join him in the study of some group of fishes or collection of fishes upon which he (Dr Jordan) was engaged He would frequently ask the student to be junior author with him of the paper Dr Jordan has thus had associated with him more young men and women as junior author than any other writer whose name I now recall He thoroughly believed in the dictum of the late Colonel Francis W Parker, that "we learn to do by doing If you wish to learn to write reports of your researches, try your hand at it" Dr Jordan was an inspiring teacher The subjects he taught were usually elective, but the number of students that elected work with him was a good proportion of the whole In the graduating class at Indiana University in 1886 there were twenty-one members (Iowa University was small in those days), but of these twenty-one, five mastered in zoology, four of the five in ichthyology, and four of the five became professional zoologists One of the best ways to measure the greatness of a teacher is to consider what becomes of his special students

As an educator Dr Jordan was no less great. His influence upon educational theory and practice has been profound Even while yet at Butler College he had begun to advocate the giving of greater freedom to the student in the selection of the subjects that should be required for graduation. When he went to Indiana University in 1879 he continued to speak for greater elasticity in the curriculum When he became president of Indiana University in 1885, he at once began to put the elective system into effect He believed that the natural and physical sciences and modern languages are no less valuable than mathematics and the dead languages for mind development and training, and that their cultural value should be recognized Under this system the student's major professor becomes his counselor and guide. With the opening of Stanford University in 1891 with Dr. Jordan as its first president, then the really great opportunity came and Dr. Jordan embraced it with all his wonderful power and enthusiasm. With a faculty of his own selection of able young men with un-bounded enthusiasm and an institution unhampered by tradition, the time was auspicious for a great adventure in higher education It was made, and what was largely educational heresy then is now accepted throughout America Under Dr Jordan's influence the natural sciences became respectable parts of the college curriculum

Although Dr Jordan was deeply interested in all branches of natural history, his special field was ichthyology His first paper, however, appears to have been botanical, on "The Colors of Vegetation," published in 1873, and his next, published the same year, was on "Hoof-rot in Sheep," both no doubt resulting from his observations on the old farm where he was born and reared In 1874 he published in the *American Naturalist* two botanical papers, and the next year he published, also in the *American Naturalist,* his first contribution to ichthyological literature, "The Sisco of Lake Tippecanoe" He described the sisco as a new species under the name of *Argyrosomus Sisco* Jordan This was the first new species of fish ever described by Dr Jordan Since that year Dr Jordan collected fishes in many waters in many parts of the world, and he described and named nearly a thousand new species and about five hundred new genera of fishes For more than twenty years he was the most active ichthyologist in the world, and for more than thirty years he was the most distinguished student of fishes in the world

In his study of fishes Dr Jordan was interested in finding out what different kinds or species are found in different waters, and the relationship between those of one stream to those of other streams. To interpret the problems of geographic distribution it is necessary to know the species involved, hence careful comparison, study of differences and resemblances, is necessary, in short, to understand the origin of species it is necessary to know what the species are Dr Jordan did not limit his study of species of fishes to an examination of research collections, he was one of the keenest, most observing of field naturalists, he "knew fishes when he met them in their native waters" and was interested in their ecological relations

A complete bibliography of Dr Jordan's papers and books on fishes is not at hand, but it contains more than 450 titles These contributions varied in size from a few pages to one of 3,528 pages and 392 plates.

Dr Jordan once said. "I have lived three more or less independent lives first, and for the love of it, that of naturalist and explorer, second, also for the love of it, that of teacher, and third, from a sense of duty, that of minor prophet of Democracy" And he adds that "if he had his days to live over, he would again choose all of the three" And each of these lives, filled with life's enthusiasms and faith in the final triumph of truth and righteousness in the world, he lived joyously

For David Starr Jordan was a man who enjoyed life and who gloried in the opportunities that came to him to use his tremendous mental and physical strength for the good of his fellow man His power of memory was astounding, his knowledge profound. He was an inspiring teacher, kind, sympathetic, utterly unselfish, and always ready to give encouragement to any student who seemed to need it

Dr Jordan was very unassuming and of marked simplicity, to his intimate associates, he seemed always a big brother, a big overgrown boy, big in body and in mind, but, withal, a boy We were not always sure whether to take him seriously I rarely or never saw him "lose his head," or become openly angry In spite of frequent display of wit and humor, he was always dignified and in a big way, we never "slapped him on the back," nor called him by his first name His humorous and witty expressions and his pithy aphorisms were wonderfully helpful in his teaching. On one occasion a bright but convivial young man applied for a certain position with which Dr Jordan was concerned Dr Jordan, in telling us about it, said "The job is too big for a boozer We can't run our plant on cocktail power and cigarette smoke"

I can do no better than to close this notice with the felicitous words written by President Herbert Hoover as the dedication to David Starr Jordan of "The Stanford Quad" for the collegiate year 1929–30.

> First president of our beloved university, creator of its oldest traditions, scientist of unquenchable thirst for truth and of unalterable integrity in its search, teacher of sympathy and imagination, friend of youth, wise counselor, believer in the inviolable sanctity and worth of the individual human soul, exemplar of the moral virtues, inspirer to the spiritual life, apostle and prophet of peace, this book is dedicated with veneration, devotion, and affection

Barton Warren Evermann

MEMORIALS

The suggestion has been made that a statue of the late Dr Stephen Moulton Babcock be erected in recognition of his generosity in giving his test for butter fat in milk to the public as well as of the many other contributions to dairy science which he made It is felt that a fund of approximately $30,000 should be raised to insure a statue and setting worthy of the purpose and the donors. The Babcock statue fund will serve as a token of appreciation from those of his generation who contribute to it and as an incentive to future generations to stimulate them to future good deeds. Contributions to the fund are now in order and may be sent to the treasurer, Professor E H. Farrington, University of Wisconsin, Madison, Wisconsin

RECENT DEATHS

Dr James W Gidley, assistant curator of fossil mammals in the U. S National Museum, died on September 26, at the age of sixty-five years

Dr George Thomas Elliot, emeritus professor of dermatology at Cornell University Medical School, died on September 14, aged seventy-five years

Dr. Harry Phillips Davis, vice-president and director of the Westinghouse Electric and Manufacturing Company and chairman of the National Broadcasting Company, died on September 10, at the age of sixty-three years

Dr John B Deaver, emeritus professor of surgery and formerly head of the department in the school of medicine of the University of Pennsylvania, died on September 25, in his seventy-sixth year

Arthur Kendrick, formerly associate professor of physics at the Rose Polytechnic Institute and president of the International Equipment Company, died on September 23, aged sixty-six years

William A Titus, assistant technical superintendent of the Western Electric plant at Chicago, died on September 19 He was fifty-one years old

Dr William A Ewing, well-known surgeon and past president of the Dayton Academy of Medicine, died on September 17. Dr Ewing was in his fifty-fifth year.

Dr. Andrews A. Cairns, director of the Municipal Department of Health in Philadelphia, died on September 9, aged sixty-seven years.

Dr. Stewart LeRoy McCurdy, organizer of the Pittsburgh Dental College, now the dental school at the University of Pittsburgh, died on September 8 at the age of 72 He had been an instructor in the school since 1896

Mr. Donald Fairfax Whiting, an electrical engineer with the Fox Films, Inc, who was forty years of age, was killed on September 7 by falling from a tree

Dr. Samuel H Chapman, member of the advisory board of the department of archeology at the University of Pennsylvania, died on September 22, in his seventy-fifth year

Sir William J R Simpson, director of tropical hygiene at the Ross Institute at Putney, England, died on September 20 He was seventy-six years old

Mr. Matthew Moncrieff Pattison Muir, senior fellow of Gonville and Caius College, Cambridge, formerly praelector in chemistry at Caius College, died on September 2, aged eighty-two years.

Mr. David Davies, well-known English paleobotanist, died on August 15 at the age of sixty-one years

Miss Joan B Procter, curator of reptiles at the London Zoological Gardens, died on September 20, after a long illness She was thirty-four years old.

SCIENTIFIC EVENTS

THE INTERNATIONAL ILLUMINATION CONGRESS

The International Illumination Congress opened on September 1, when Mr C C Paterson, the president, and others prominently associated with illuminating engineering and the lighting industry were present at the reception bureau at London University in order to greet delegates from all countries Although the original estimate of the attendance was in the neighborhood of 400, there were over 500 names on the official list when the congress opened According to the *Electrical Review*, something like twenty different countries were represented.

The program in London from September 1 to 3 was mainly social It included facilities for visiting the E L M A. Lighting Service Bureau, the General Electric Company research laboratories at Wembley, the National Physical Laboratory, and other institutions of special interest in connection with lighting, as well as places of national and historic interest.

The proceedings included a luncheon on September 1 at the Savoy Hotel, given by the Gas Light and Coke Company and the London electricity supply undertakings, at which the toast of "The International Illumination Congress" was proposed by Mr. George Lansbury, who, on behalf of H. M. Office of Works, had taken a very sympathetic interest in the work of the congress and the floodlighting arrangements. An address of welcome was also delivered in English, French and German by Lieutenant-Colonel Kenelm Edgcumbe, chairman of the general council of the congress, who presided, and M. A. Filliol, of Switzerland, honorable treasurer of the International Commission on Illumination replied in English and French on behalf of the foreign delegates

Following the luncheon there came what was undoubtedly the chief item of the London entertainments, namely, a river tour starting from Waterloo Bridge at 2 30 P M, visiting Greenwich and returning by the Tower of London and Westminster by 10.30 P M. This trip afforded an excellent opportunity of seeing the floodlighted buildings, which were visible from the river, and of witnessing the performances of *H. M. S President* off the Embankment, *H. M S Scout* in the Pool of London, and the illuminated fire-floats off Hungerford Bridge From 10 30 P M. onwards a motor tour for the purpose of viewing other floodlighting installations, not visible from the River Thames, including the display of floodlighting with gas in St James' Park and the super-illumination of Whitehall, had been arranged

During the evening of the second day of the congress a banquet was arranged at the Dorchester Hotel, London, when the toast of "The International Illumination Congress" was proposed by Sir Hugo Hirst, chairman of the General Electric Company, Ltd, supported by Mr Henry Woodall, deputy governor of the Gas Light and Coke Co, speeches were delivered by Professor E C Crittenden, of the United States, M A Filliol, of Switzerland, and Herr E Wissmann, of Germany, on behalf of the foreign delegates Following the banquet a motor tour of London's streets was planned for some of the guests.

Following the congress more technical questions will be dealt with during the International Commission sessions at the University of Cambridge On September 3 the congress moved on from London to Glasgow, and in due course, Edinburgh, Buxton, Sheffield and Birmingham were visited, prior to the session of the International Commission on Illumination, which took place in Cambridge from September 13 to 19.

COMMITTEE APPOINTMENTS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

AT the August meeting of the board of directors of the American Institute of Electrical Engineers, President Skinner announced the committee appointments for the administrative year beginning August 1, 1931. The chairmen of the general committees are as follows:

Board of Examiners: H Goodwin, Jr, consulting engineer, Philadelphia, Pa.

Finance. C E Stephens, vice-president and northeastern district manager, Westinghouse Electric and Mfg Company, New York, N. Y.

Publication. E. B Meyer, vice-president, United Engineers and Constructors, Inc, Newark, N. J

Meetings and Papers · W. H. Harrison, plant engineer, American Telephone and Telegraph Company, New York, N. Y.

Sections. Everett S Lee, general engineering laboratory, General Electric Company, Schenectady, N Y

Membership. R L Kirk, assistant to the vice-president, Duquesne Light Company, Pittsburgh, Pa

Law · W S Gorsuch, engineer of economics, Interborough Rapid Transit Company, New York, N Y

Coordination of Institute Activities H P Charlesworth, vice-president, Bell Telephone Laboratories, New York, N Y

Student Branches W H Timbie, professor of electrical engineering and industrial practice, Massachusetts Institute of Technology, Cambridge, Mass

Headquarters R. H. Tapscott, electrical engineer, New York Edison Company, New York, N Y

Public Policy B Gherardi, vice-president and chief engineer, American Telephone and Telegraph Company, New York, N Y

Standards A M MacCutcheon, engineering vice-president, Reliance Electric and Engineering Company, Cleveland, Ohio

Edison Medal D C Jackson, head of the department of electrical engineering, Massachusetts Institute of Technology, Cambridge, Mass

Lamme Medal C C Chesney, honorary vice president, Pittsfield Works, General Electric Company, Pittsfield, Mass

Code of Principles of Professional Conduct R. F. Schuchardt, chief electrical engineer, Commonwealth Edison Company, Chicago, Ill

Award of Institute Prizes W H Harrison, plant engineer, American Telephone and Telegraph Company, New York, N Y.

Safety Codes J C Forsyth, supervising engineer, New York Board of Fire Underwriters, New York, N. Y.

Columbia University Scholarships W I Slichter, professor of electrical engineering, Columbia University, New York, N Y

Legislation Affecting the Engineering Profession H. A. Kidder, Superintendent of Motive Power, Interborough Rapid Transit Company, New York, N Y

Economic Status of the Engineer C O Bickelhaupt, assistant vice-president, American Telephone and Telegraph Company, New York, N Y.

Advisory Committee to the Museum of Science and Industry in the City of New York John Price Jackson, manager, department of personnel and statistics, Manhattan district, New York Edison Company, New York, N Y

WILD LIFE IN NATIONAL FORESTS

A CONTINUOUS yield of fish and game for the woods and streams in the national forests, with replenishment each season, like the repetition of field crops is the ideal of the U S Forest Service, according to the chief forester, Mr. R. Y. Stuart Mr. Stuart states that the total production of fish and wild life of the country is inadequate to meet the ever-increasing demand for outdoor recreation and that the Forest Service aims to restore and develop recreational and fishing opportunities.

The national forest program is fitting itself into public plans and the Forest Service is ready to cooperate in any sound national game program

The continuous yield of fish and game as a practical working principle is gaining ground That certain species are almost extinct on some areas, that there is a satisfactory breeding stock with inadequate increase on other areas, while still other areas are overpopulated, clearly indicates the need of applying the principle on national forests All land and water are capable of producing some species of fish or game or fowl or fur-bearing animals, or a combination of them, beneficial to mankind

In reference to game refuges and stocked streams, he says, it is immaterial whether state or federal agencies take the responsibilities for their regulation and productivity, so long as such areas are administered effectively A total of 267 state game refuges, including more than 20,000,000 acres, has been established on national forest land These areas are administered jointly by the states and the Forest Service In a few cases refuges have already developed an overpopulation of wild game But generally a maximum of fish in the streams and lakes can only be obtained by hatching and releasing many millions of fish of the proper size

To give the game and fish a fair opportunity it is necessary to protect the refuges from unlawful hunters and fishers, predatory animals, parasites, and also from forest fires Fires are as fatal to fish as to animals Loss follows from unregulated streamflow, mud, poisoning by ashes and destruction of natural food through a combination of these conditions

The growth of public sentiment against fire has been of great help, and last year, for the first time in history, forest fires in the national forests of the United States were kept down to a safe minimum

At this time stream surveys are being made in national forests to determine the fish-carrying capacity of the streams, the adaptability of streams to various species, and to prevent duplication of effort The Bureau of Fisheries and the state game and fish commissions are cooperating in gathering this information.

THE NEW AGRICULTURAL ENGINEERING BUILDING AT THE UNIVERSITY OF KENTUCKY

The new $75,000 agricultural engineering building completed recently on the experiment station farm of the University of Kentucky is now occupied by members of the faculty, and the shops, laboratories and classrooms are being equipped for school work during the present semester The building is of Southern colonial architecture, built of concrete and brick, and is fireproof throughout. The main part consists of two stories and basement, and the one-story wings form a U-enclosure for a machinery court in the rear The structure is 198 feet across the front and 98 feet deep

The basement houses drainage, sanitation equipment and concrete work laboratories and storage room for lumber, supplies and machinery The first floor is given over to laboratories for farm motors, tractors, machinery, buildings, shops, experimental work, the crops drying and storage rooms, tool and recitation rooms On the second floor are offices, drafting and blue-printing rooms and classrooms

Manufacturers and dealers in farm equipment are cooperating by lending machinery and other equipment for the new building, including motors, tractors, pumps, sanitary equipment, rural electrical equipment, barn and other building materials, and practically every type of field machinery used in Kentucky This equipment will be kept up to date, in order that students and visitors may see the latest types of farm machines and other equipment

The agricultural engineering department is allied with the agronomy department of the experiment station and college of agriculture for administrative purposes The personnel of the department consists of Professor J B Kelley, professor of agricultural engineering, who is in charge, Earl G Welch, extension agricultural engineer, and Howard Matson, part-time instructor and part-time extension engineer Courses are offered to college students covering the various phases of agricultural engineering, such as farm motors, farm buildings, farm machinery, sanitation equipment, rural electrification, farm drainage and the prevention of soil erosion

THE PUBLICATION OF NEWTON'S CORRESPONDENCE

The fact that no edition of Newton's correspondence is available, which has constituted sometimes a surprise for the "honnête homme," is always a terrible handicap to the scientist, to the scholar and especially to the historian of science Even with the help of the biographies and bibliographies of Edleston, Brewster, Gray and Zeitlinger, which are not always complete, one is too often vexed because the letters of the illustrious Englishman are sometimes practically lost in almost inaccessible works or collections and also because a great number of them—without which one may not hope to describe with precision the evolution of Newton's thought—are still missing, simply owing to the fact that no systematic attempt to collect them has ever been made The relative ease with which several of them have been traced in recent years proves this last point

In a letter published in *Nature* a few years ago, Sir Joseph Larmor has recalled how a project developed in the beginning of this century at Cambridge for an edition of Newton's works failed " . As time passed it became clear, to me at any rate, that a committee of editors could not be very effective, especially when it consisted of men primarily intent each on his own scientific pursuits Thus no effort has since been made to push the project But one may be permitted to express the view that a systematic collection of the letters remains most desirable, and the hope that some day that part of the scheme may be realized" It may be recalled that even the hope to form in England a Newton Society has been given up, too, according to the late Professor H H Turner

A comprehensive and critical edition of Newton's correspondence must, of course, include all the memoirs written under the form of letters to Oldenburg, and published in the *Philosophical Transactions,* very often with alterations and omissions, the letters by Newton's correspondents, extracts from the letters of contemporaries which concern him, and his own letters, of which those now known number something less than 250 The Adam-Tannery edition of Descartes' correspondence is perhaps the best model to be followed The realization of this project would no doubt constitute by far the most important contribution to the celebration in 1942 of the tricentenary of the birth of Newton.

SCIENTIFIC NOTES AND NEWS

PLANS have been completed by the Association of Illinois Chemists for having portraits painted of Professor A W Palmer, who was head of the chemistry department at the University of Illinois from 1894 to 1904, Professor W A Noyes, director of the chemical laboratory from 1906 to 1926, and Professor S W Parr, in charge of applied chemistry from 1894 to 1926 These men stand out, not only as leaders among American chemists, but also as the individuals who have done most to develop a successful chemistry department at the university The portraits will be hung in the Chemical Library as an inspiration to all the younger students in chemistry Dr N W Krase is secretary of the committee

MR PHILIP DRINKER, assistant professor of ventilation and illumination in the school of public health of Harvard University, and Louis Agassiz Shaw, also of the school of public health, have been awarded the John Scott Medal for the invention of the Drinker respirator Presentation of the medals will be made in the hall of the Franklin Institute on November 12

IN celebration of Dr Walter Bradford Cannon's twenty-five years as George Higginson professor of physiology in Harvard University, the afternoon and evening of October 15 have been set aside for exercises befitting the occasion, at the Amphitheater, Building C, Harvard Medical School, at 4 P M, with Dr David L Edsall presiding Papers will be given by Dr Walter C Alvarez, of the Mayo Clinic, on "Influence of Dr Cannon's Work upon Medical Thought and Progress" and by Dr William H Howell, of the Johns Hopkins School of Hygiene, on "The Development of Physiology during the Past Twenty-five Years, and Dr Cannon's Influence upon It" At 7 30 P. M a dinner will be given at the Vanderbilt Hall Gymnasium, at which President Lowell will preside. Dr. Graham Lusk, professor of physiology of the School of Medicine of Cornell University, will speak on "The Life of a Professor" The presentation to the medical school of the portrait of Dr Cannon will then take place The committee in charge are Dr Henry A Christian, *chairman*, Dr Harvey Cushing, Dr Alexander Forbes, Dr Alfred C Redfield and Dr Cecil K Drinker

SIR HUBERT WILKINS, well-known Arctic explorer, was presented with a gold medal and diploma of the Italian Royal Geographical Society on July 23 on board the *Nautilus,* in recognition of his services to science in connection with polar research work

THE American Astronomical Society has elected the following new officers besides the president, Dr W S Adams, whose election was announced in SCIENCE last week *vice-president*, Dr. C G Abbot, director of the Astrophysics Observatory of the Smithsonian Institution, *councillors*, J C Hammond, astronomer at the U S Naval Observatory, P W Merrill, astronomer at the Mt Wilson Observatory, and H H Plaskett, director of the Dominion Observatory of Canada Benjamin Boss, director of the Dudley Observatory, was reelected treasurer, and R S Dugan, professor of astronomy at Princeton University

DR ISAIAH BOWMAN, of New York, director of the American Geographical Society, has been elected president of the International Geographical Union at its closing session in the University of Paris on September 24 The next meeting of the union will be held in Warsaw in 1934 General Robert Bourgeois, of France, was elected first vice-president General Vacchell, of the Military Geographical Institute at Florence, Professor E Romer, of the University of Lvov, Poland, Brigadier Harold Winterbotham, director-general of the Ordnance Survey of Great Britain; Professor Nunez, of Spain, and Sir Ahmed Mohamed, of Egypt, were elected second vice-presidents The congress was attended by more than 800 delegates from thirty-four nations, including fifty delegates from the United States The meeting closed on the evening of September 24 after a banquet was given to the leaders of the delegations and a reception to delegates

Dr. Jay F Schamberg, professor of dermatology and syphilology in the Graduate School of Medicine at the University of Pennsylvania and director of the Dermatological Research Institute in Philadelphia, was installed as president of the Philadelphia County Medical Society on September 23 He gave the presidential address of acceptance, and an oration was delivered by the retiring president, Dr George P Muller, professor of clinical surgery in the medical school of the University of Pennsylvania Other officers installed were Dr Charles F Nassau, clinical professor of surgery at Jefferson Medical College, as president-elect, Dr W. Burrill Odenatt, vice-president, Dr Henry G Munson, secretary, and Dr R Powers Wilkinson, treasurer Associate vice-presidents who take office are Dr L C Hamblock, Dr C Fisher, Dr E Paul Reiff, Dr William H Chandlee, Dr Francis V Gowan and Dr Samuel Cohen Dr George C Yeager, recently elected vice-president of the American Medical Association, Dr Francis Ashley Faught and Dr Nathan Blumberg are the newly elected members of the board of directors.

Dr. Arthur W Goodspeed, professor of physics in the college at the University of Pennsylvania and director of the Randal Morgan Laboratory of Physics, has retired at the age of seventy-one years. Dr. Goodspeed has been connected with the university since 1884. Other retirements include Dr Albert E. Roussel, professor of medicine, and Dr James E Talley, professor of cardiology

Dr. J Paul Visscher has been appointed professor and head of the biology department at Western Reserve University

Dr Douglas R Drury, of Harvard University and associate physician at the Huntington Memorial Hospital in Boston, has been made professor of physiology at the University of Southern California.

At Lafayette College, John H Wilson has been made professor of chemistry, and Professor Paul B Eaton head of the department of mechanical engineering Those advanced to the rank of associate professor are James H DeLong, in chemistry, Harry A. Itter, in geology, and Ernest M Fernald, in mechanical engineering Instructors promoted to the rank of assistant professors are: Charles K Cabeen, in geology; William Beverly, in mathematics, Charles M. Merrick, in mechanical engineering. The following instructors have been appointed Robert J Crosen, in chemistry; Charles T. Brown, in physics; Harry L. Anthony, in mining engineering, and Paul P. Price, in civil engineering.

The Pennsylvania State College has announced the appointment of the following department heads: Professor H A Everett, professor of thermodynamics, to be head of the department of mechanical engineering; Dr Harry B Northrup, formerly acting head of the department of metallurgy, to be head of the extension division of the school of mineral industries, Dr. Albert W Gauger, formerly head of mines and mining experiments at the University of North Dakota, to be director of mineral industries research and professor of fuel technology

Additions to the faculty of George Washington University include Dr L. Edwin Yocum, assistant professor of botany, Dr Albert Spear Hitchcock, professorial lecturer in botany, Dr Herman Henry Kaveler, instructor in chemistry, and Paul Hugh Emmett, lecturer in chemistry In the school of medicine, Lieutenant Commander Franklin Forman Murdoch, acting executive officer of the Naval Medical School, will become professor of tropical medicine, and Myron C Waddell has been appointed instructor in anatomy.

Dr. J C. Geiger, professor of epidemiology of the George Williams Hooper Foundation for Medical Research and the University of California Medical School, San Francisco, has been appointed health officer of the city and county of San Francisco, filling the vacancy created by the sudden death of Dr William C Hassler.

Dr. John M Nokes, formerly of Nashville, Tennessee, has been appointed assistant professor of obstetrics and gynecology at the Medical School of the University of Virginia.

Promotions and appointments in the faculty at Jefferson Medical College have been announced as follows: Edward J. Klopp, professor of surgery; Thomas A Shallow, professor of surgery; George Russell Bancroft, professor of physiological chemistry and toxicology; Charles F Nassau and Arthur E. Billings, clinical professors of surgery, George A. Ulrich, clinical professor of obstetrics; Michael A. Burns, associate professor of nervous and mental diseases; Arthur J Davidson, associate professor of orthopedic surgery; H. Hunter Lott, assistant professor of laryngology, A. Spencer Kaufman, assistant professor of otology; Benjamin P. Weiss, assistant professor of nervous and mental diseases; James R. Martin, assistant professor of orthopedic surgery; B. B. Vincent Lyon, assistant professor of medicine; Collin Foulkrod, assistant professor of obstetrics; Lorenz

P. Hansen, assistant professor of physiological chemistry.

Dr. Helene Wastl, of the University of Vienna, has been appointed as acting professor of physiology at the Woman's Medical College of Pennsylvania, Dr Sarah I Morris, assistant professor of clinical medicine at the University of Wisconsin, has been made acting professor of preventive medicine and physician to the students, Dr S Brandt Rose has been promoted to the chair of bacteriology, and also becomes director of the clinical laboratory of the hospital, Dr Mary J Evans will act as assistant laboratory director. Other appointments are Dr Beatrice Rettinger, chief resident physician of the hospital, Dr William John Ryan, demonstrator in surgery, Dr Allan P Parker and Dr. Herbert H Fritz, instructors in surgical anatomy, Dr William T Lemmon, instructor in surgery; Dr Mary Elizabeth Howe, instructor in anatomy, Dr Miriam Butler, assistant instructor in pediatrics

Dr Floyd De Eds, formerly of the National Institute of Health of the U S Public Health Service, has been appointed senior toxicologist for the U S Department of Agriculture. He will be stationed in the department of pharmacology, Stanford University School of Medicine, San Francisco, to carry on investigation of chronic intoxications for the bureau of chemistry and soils.

David Twomey has been made assistant professor of psychology and Peter J McKane has been made assistant professor of physics, at Boston College

Dr. William H. Gauger has been appointed instructor in the department of chemistry and chemical engineering at the University of Maine

Dr Carey Croneis, of the University of Chicago, has recently been promoted from assistant professor to associate professor of geology. Dr Croneis has also been appointed research associate of the Museum of Science and Industry in charge of designing the geology exhibits in the division of geology and mineral industries. This division, when completed, will comprise 23 rooms and will occupy approximately 70,000 square feet of floor space. Mr. Louis Frederick Hampel has also joined the staff of the museum as assistant curator of social sciences.

Dr. Adrian J. Pieters, who has been acting in charge of the division of forage crops and diseases of the U. S. Bureau of Plant Industry, has been appointed head of the division.

Professor J. F. Wilson, wool specialist of the University of California animal husbandry division at the branch of the College of Agriculture, at Davis, California, has been chosen chairman for the 1932 conference of animal husbandmen at Miles City, Montana The position carries with it the western vice-presidency of the American Society of Animal Production

Dr. John Elton Lodewick, professor of wood technology at the Virginia Polytechnic Institute, has been appointed chief of the forest-products section of the Pacific Northwest Forest Experiment Station, the Forest Service has announced He succeeds W H Gibbons, who was chief of forest-products work at this station for many years and who recently has been transferred to the Washington, D C, office of the U S. Forest Service

Dr D T Ries, who until its termination on July 1 was employed by the Plant Quarantine and Control Administration on the Mediterranean fruit-fly project at Orlando, Florida, has been appointed curator of entomology at the Cranbrook Institute of Science, Bloomfield Hills, Michigan

Dr. Albert Kenrick Fisher, senior biologist of the bureau of biological survey, U S Department of Agriculture, and for many years head of its division of economic investigations, was retired on August 31. Dr. Fisher now becomes a zoological collaborator of the U S. National Museum

The Charles Sumner Bacon Lectures (third series) will be given on October 8 and 9 in Lecture Hall No 221, at the University of Illinois College of Medicine, 1853 Polk Street, Chicago, by Dr Herbert M. Evans, professor of anatomy at the University of California. The general subject of the lectures is "The Function of the Anterior Hypophysis" These lectures will be open to the public

Dr. E D Adrian, fellow of Trinity College, Cambridge, and Foulerton research professor of the Royal Society, will deliver the Eldridge Reeves Johnson Foundation Lectures at the University of Pennsylvania from October 13 to 28 on "The Mechanism of Nervous Action—Electrical Studies of the Neurone." The series will be given in the medical clinic of the university at 4:15 on the following dates· Tuesday, October 13, "The Nerve Fiber as a Means of Communication", Wednesday, October 14, "The Sensory Message and Its Relation to the Stimulus", Tuesday, October 20, "The Action of Different Sense Organs, Some Outstanding Problems"; Wednesday, October 21, "Impulses in Efferent Nerves: The Grading of Muscular Contraction. Sympathetic Discharges", Wednesday, October 28, "The Activity of the Nerve Cells"

The spring meeting of the American Electrochemical Society is scheduled for April 21, 22 and 23, 1932, at Baltimore, the home of the largest electrolytic copper refinery in the world The headquarters of the meeting will be at the Lord Baltimore Hotel. The subject for the main scientific-technical session, at which Dr J T MacKenzie will preside, will be "The Electric Furnace and its Products" Manuscripts on any phase of the electric furnace art are welcome and should be mailed to the secretary before February 15, 1932 The round table discussion will be under the direction of Mr F A Lidbury, of Niagara Falls The topic of the discussion will be "Electrochemistry and the Fertilizer Industry" There have been a number of very radical changes in the fertilizer industry during recent years and an opportunity will be afforded to all members and guests to express their views and recommendations in the round table discussion The electrothermic division is inviting one of the foremost electric furnace engineers of Europe to report upon the recent developments in the electric furnace art abroad Dr Duncan MacRae, of the Edgewood Arsenal, is chairman of the local committee Trips to various industrial plants are planned, among them being the U S Industrial Alcohol Company, the Baltimore Copper Works, the American Refractory Company and the Bethlehem Steel Company

The Roumanian Medical Association held its annual congress recently in Constanza, a picturesque seaport on the shore of the Black Sea According to the Bucharest correspondent of the *Journal* of the American Medical Association, the congress was attended by more than 700 physicians, most of them accompanied by their families The presidential address was given by Professor Hatiegan, the minister of Transylvania Afterward Professor Cantacuzino read a paper on Calmette's vaccination After the paper had been read, the president of the medical association, the professorial staff of the Roumanian universities, and the different medical formations, together with the delegates of the allied professions, solemnly greeted Professor Cantacuzino on the occasion of his appointment as minister of public health The board of the medical association established a foundation, the annual interest of which, 10,000 lei, is to be given as a prize to the writer of the best dissertation emanating from the institute for the production of serums and vaccines, carrying the name of Professor Cantacuzino A special committee was appointed with Professor Cantacuzino as president, to award the prize

The permanent committee of the International Union of Forestry Research Organizations met on September 7 at the office of the Forestry Commissioners, Savile-row, England The committee prepared for the next meeting of the international union, which is to be held in France in 1932. The union comprises over eighty forest research organizations in thirty countries The members of the committee present were M P Guinier (France), president of the international union, Herr Sven Petrini (Sweden), secretary-general to the international union, Professor H Badoux (Switzerland), director of the Swiss Central Institute for Research, Professor L. Fabricius (Germany), director of the Institute for Research at Munich, Professor Aldo Pavari (Italy), director of the Institute for Research at Florence, and Sir Roy Robinson (Great Britain), vice-chairman of the Forestry Commission The representatives of Hungary and Poland were unable to be present In the afternoon the committee visited Kew Gardens, and the members were the guests of H M Government at a dinner at the Hotel Splendide, when Lord Londonderry presided Later the committee visited some of the state forest areas in the west of England and in Wales

The Royal College of Physicians of Edinburgh will celebrate on St Andrew's Day, November 30, the two hundred and fiftieth anniversary of its founding The charter of the society was granted by Charles II in 1681 to a group of young physicians under the leadership of Sir Robert Sibbald

It has been announced recently that the Association for the Advancement of Science in Marketing has been organized Its object will be actively to encourage a scientific approach to marketing problems The provisional officers are as follows *President,* Paul T Cherrington, distribution consultant, *first vice-president,* L D H Weld, research director, McCann-Suckow, Inc , *secretary,* N W Barnes, Marketing Associates, Inc , *treasurer,* A M Crossley

Bowdoin College has received $50,000 by the will of the late Edwin Bradbury Smith

The late Professor W D. Halliburton, who died on May 21, has bequeathed, on the death of his wife, £10,000 to King's College, University of London, for endowment, or towards the salary of a professor in the subject of physiology or the sciences relating thereto

Dr Henry G Knight, chief of the U S Bureau of Chemistry and Soils, has announced that a new citrus laboratory, for which funds were appropriated by the last Congress, will be established in the citrus-growing territory of the Rio Grande Valley at Weslaco, Texas, on the state-owned land of the Texas State Experiment Station The selection of the site was made upon recommendation of Dr F C Blanck, who is in charge of the food research division of the Bureau of Chemistry and Soils, and E M Chace, of the bureau's fruit and vegetable laboratory at Los Angeles, California, and with the approval of Director A. B. Conner, of the Texas Agricultural Experiment Station.

DR. WILLIAM FRANCIS THOMPSON, director of investigations and professor of fisheries for the International Fisheries Commission at the University of Washington, has recently completed the preliminary studies called for by a treaty in 1924 between Canada and the United States establishing a commission for investigation of the halibut fisheries. As a result of these studies, a new treaty dealing with the regulation of the fisheries and continuing the scientific work has been signed and confirmed. This is said to be the first treaty for the conservation of a species of marine fish.

DISCUSSION

THE MEGAGAMETOPHYTE OF PINUS

THE classic work of Hofmeister presents the development of the megagametophyte of several gymnosperms which he studied in the years 1848 and 1849. He introduced for the first time the general course of events in the growth of the gametophyte of gymnosperms. Subsequent corrections in this life history appeared at intervals with the progressive improvements in the methods of histological technique. Hofmeister, influenced no doubt by his study of the life history of mosses and ferns, concluded that the megagametophyte of gymnosperms grows in a manner similar to that of the Fern Allies, as he knew of it in *Selaginella*. Up to the present time this conclusion in general has been accepted by most botanists.

That the gymnosperms and Fern Allies are closely related has been seriously questioned recently by workers in paleobotany and plant anatomy. This controversy concerning the phylogeny of gymnosperms brought forth the expression that the evidence obtained from a study of plant morphology is unreliable as an indicator of relationship. Unfortunately we have only a fragmentary knowledge of a few of these life histories and none are complete in every detail.

The description of the growth of the megagametophyte of *Pinus* as presented in current botanical literature is incomplete and inaccurate. Evidence of a centripetal growth of the gametophyte has not been found in any of the gymnosperms other than *Pinus*. In *Pinus* centripetal growth has been inferred but the progress for such a development has never been presented in detail. There is too little evidence to support the general rule that centripetal growth of the megagametophyte occurs in most of the gymnosperms. In a text-book of botany of recent publication, we find the growth of the megagametophyte conveniently arranged in five stages.

> The female gametophyte, in nearly all gymnosperms, develops in a general way as in *Selaginella* and *Isoetes*. At least five stages in the development should be borne in mind, (1) Free nuclear division by which a varying number of free nuclei are distributed through the cytoplasm of the megaspore, (2) Parietal placing of these nuclei by the development of a central vacuole, (3) Continued free nuclear division, (4) Formation of a parietal tissue by the development of cell walls separating the free nuclei, (5) Centripetal growth of this tissue until it fills the cavity of the enlarging megaspore which is now known as the embryo sac.

The proper view of the development of the megagametophyte of *Pinus*, as obtained by a study of a close series of *Pinus flexilis* and *P. scopulorum* collected in the Rocky Mountain National Park, Colorado, during the past three growing seasons, differs greatly from the present accepted description. The various phases of growth will be given in the order comparable to the five stages in the previous quotation. (1) After the megaspore mother cell has divided, the first cell of the gametophyte remains in the resting stage until the zone of nutritive cells (spongy tissue) becomes active. This nutritive tissue persists for a long time in the digestion of the nucellus. (2) As a result of the activity of the digestive tissue and the enlargement of the nucellus, a large vacuole is formed. The megagametophyte develops by free nuclear division in the center of the enlarging vacuole. (3) The cytoplasm surrounding the free nuclei remains connected in strands and the young gametophyte in the center of the vacuole takes on the form of a tangled skein or network. (4) A megagametophyte consisting of a separate parietal tissue surrounding a central cavity does not appear in normal sporangia. Nutritive cells in the final stages of digestion, however, are still present in a parietal position at the time archegonia first appear. (5) The normal growth of the gametophyte is centrifugal, never centripetal. The embryo sac is completely filled by the gametophyte at the time of fertilization or soon after.

In the development of a carpellate cone of *Pinus*, two or three years, depending on the species, are required for the seeds to reach maturity. During this time interval the number of abortive ovules gradually increases as development progresses. The carpels externally appear alike at maturity but the number of seeds in a cone may vary from a few to a hundred or more. The average number of mature seeds found is seldom as great as fifty per cent. of the total number capable of development.

At any time during the growth of the gametophyte, development may be arrested. Many megasporangia fail to renew their growth in the spring following the dormant period of winter In *Pinus nigra* var *austriaca* soon after the beginning of the second growing season the megagametophyte of abnormal sporangia takes on the form of a hollow sphere very much in appearance like a Volvox colony In the process of disintegration the free cells of this abnormal gametophyte press out toward the margin of the vacuole and there assume the parietal position. These gametophytes never develop archegonia It is possible that a person limited to material of one season may happen on abnormal ovules with the free nuclei of the gametophyte in a parietal position and later in the season he may obtain normal material with archegonia and gametophyte in a central position From such a combination of abnormal and normal materials centripetal growth of the gametophyte might be inferred

W H EMIG

UNIVERSITY OF PITTSBURGH

PAUROPODA IN ALASKA

I HAVE been studying small and somewhat obscure arthropods of several widely separate groups, but with a number of features in common They have no wings, they have no eyes and they live in decaying vegetable material under logs or stones or in humus In the insect groups I have collected Campodea, Japyx and Protura Among the centipede-like forms I have searched for Symphyla and Pauropoda

Members of all these delicate, white, eyeless forms may all occur in one environment, but it is more common to find but one group represented in one place I have collected from the eastern United States to the western and from Cuba and Mexico to central Alaska The two insect genera mentioned above and Symphyla are by far the easiest to find Pauropoda may be obtained by the funnel method or by more direct collecting in the field, but I have never found Protura except with a funnel I did not use this apparatus in Alaska last summer, and I am not surprised that I did not find any Proturans by the methods used They may be there, I have not really made a very serious attempt to find them For the other groups I searched hours in a number of widely separated localities in Alaska, British Columbia and Yukon Territory and found not a single representative of any of the more easily collected animals The only group obtained in these northern regions was Pauropoda These were found in but four places. None were collected in southern Alaska. At Skagway several were obtained with mites, Collembola and some other insects They were under stones in a dense wood In comparing these with other previously collected specimens I found their nearest relationships were with some obtained the year before well up towards the timber line on Mt Hood, Oregon At Dawson City I was especially successful in obtaining Pauropoda It was a slightly rainy day, moisture conditions on the ground were just right, and I was able to obtain quite a number of specimens. They were about one half way up the mountain back of Dawson City Next at Eagle, Alaska, a few specimens were found in the woods about a mile from the Yukon

During several days I searched in the McKinley National Park, and although mites, small centipedes and Collembola were encountered no Pauropoda were seen at any time It may have been too damp, as heavy rains came frequently

At Currie a few more of these minute eighteen-legged forms were found All but one of the four lots encountered were of the genus Stylopauropus, those from Eagle alone were of the genus Pauropus. In fact more than nine tenths of all the specimens collected were of the genus Stylopauropus. In general to the southward Pauropus is more often encountered than the other

So far as I know this record is the first for these arthropods in Alaska and so far as I have been able to learn these must be farther north than those reported from the old world. But not finding these small animals is no sure proof that they may not be present in a region It is very easy to overlook them, as indeed all the other forms mentioned, but if one is collecting one particular kind of animal he is apt to find those which were not conspicuous I have now collected these Pauropoda from the eastern United States, from Mexico both north and south and now from Alaska. I did not find any in Cuba, although I searched in many places.

The species found differ but little from each other, rather minor characters separate them into species. Records from others as well as those of my own suggest a world-wide distribution of two genera.

WILLIAM A HILTON

DEPARTMENT OF ZOOLOGY,
POMONA COLLEGE

MORE ABOUT CITATIONS

SOME comments received since the article "A uniform scheme for citations" was printed (SCIENCE, April 10, 1931, pp. 390–392) indicate the desirability of a few additional notes.

The U. S. Geological Survey scheme is applicable not only to footnote citations but to bibliographic or other lists of publications and to synonymy. A chronologic list may be printed with the date at the beginning of each citation, as stated, or with each date centered over all the citations that belong to it In synonymy, as the workers in any one field of biology are relatively few, an author's surname is usually adequate for identification, and for this reason it is customary to omit the author's initials unless they are needed to distinguish two authors having the same surname.

The rule in the Geological Survey citations is to change Roman numerals to Arabic figures, with the single exception of page numbers. In some publications Roman pagination is used for the preliminary matter (title page, table of contents, etc.) and the main text starts with Arabic 1, so that a publication may have, for example, both page xii and page 12 Obviously Roman page numbers can not safely be changed to Arabic in a citation (In passing it may be said that any good reason for using the cumbersome Roman numerals in the original publications, except for the preliminary pages, would be hard to find They are especially objectionable as used for plate numbers "Plate CCXXXVIII," for example, is not only hard to read but occupies much space In a publication with many plates the space saved by using Arabic numerals would be an item worth considering It is time the Roman numerals were abandoned)

In citing a paper contained in a serial publication the title of the paper should be included, as well as the title of the serial. A citation that gives merely the title of the serial affords no adequate clue to the subject of the paper cited and consequently does not indicate whether or not consultation of the paper itself would be desirable for a reader who wishes to pursue the subject further.

Although in citing a paper in a journal whose numbers are paged consecutively in each volume it is not necessary for certain identification to include the number (as "vol 18, No. 3"), it is a convenience, in referring to journals that have not yet been bound, to know the particular number that contains the paper cited—that is, it may save turning over several numbers until the right one is found. This added convenience may justify the space occupied by including the number in the citation

The page numbers given in a citation should be those containing the particular matter to which reference is made. For example, in citing an authority for a specific statement the pages on which the statement is to be found should be given—not the pages covering the whole article Most bibliographies, however, are intended to cite complete articles or publications and should therefore give the limiting page numbers, or, for a separate publication, the total number of pages, in the form "484 pp" A bibliography recently submitted gave only the first page of the article for each citation, which, although enough information to enable any one to find the article cited, gave no clue to the length of the article—an item which might have an influence on the decision whether or not to consult it

Where questions of priority are involved, as in descriptions of new species, the date given at the end of the citation may include the month and day of publication—if ascertainable—as well as the year The exact date may be difficult or impossible to determine, except for a serial publication that appears at regular intervals For other publications even a date printed on the publication itself may not be absolutely reliable, as the printer must guess it in advance, and circumstances may invalidate his guess

Since the publication of the original article the U S Geological Survey scheme has been adopted by the National Bureau of Standards. The obvious advantages of uniformity would seem to recommend it to other publishing scientific organizations

BERNARD H LANE,
Editor

U S GEOLOGICAL SURVEY

VISION, AND VASCULARITY OF THE EYE

WITH the cooperation of a number of colleagues, I have made a study of the correlation of the sense of vision with the vascularity of the eye, of which this is a preliminary report Though it is generally recognized that gross alterations in the vascularity of the retina is associated with variation of vision, it has been assumed that these variations are predicated upon damage of the retinal and choroidal tissues. It has been known, for instance, that thrombosis of the retinal artery, with resultant hemorrhages in the retina, results in loss of vision Our study indicates, however, that there is a quantitative relation between the varying vascularity of the eye and its resultant nutritional status, and the sense of vision

This study was suggested by parallel work on the vascularity of the ear recently published by me, and the desire to determine what effect the method utilized for altering the vascularity of the ear, galvanization, might have upon other tissues and organs of the head In subjects with normal eyes it was not found possible to materially alter vision except by the "make" and "break" of the current, due to the rich vascularity of the eye; though it was found possible in many cases to check vision and create a sensation of "blackness" by pressure upon the carotid arteries. In cases in which the vision and the vascularity of the eye were materially reduced by disease process, such as choroiditis and retinitis with attendant vascular thrombosis, gross changes in vision associated with parallel changes in the size of the vessels of the eyegrounds have been demonstrated They have been induced by galvanization—negative galvanization causing dilatation of the vessels and marked improvement in vision, and positive galvanization causing constriction of the blood vessels and diminished vision I have thus found it possible in these cases to improve sight or to reduce vision almost to the point of blindness, at will, by means of galvanic stimulation The reversible improvement and impairment of vision as a result of dilatation and contraction of the vessels by galvanization, offers proof of the quantitative dependence of the sensation of vision upon the vascularity of the eye In a number of cases with rapidly failing vision, it has been found possible, by means of galvanic therapy, to improve the sight of the subject to a useful level and to maintain at that level for long periods of time

E M JOSEPHSON

NEW YORK CITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ABSORPTION DEVICES AND METHODS

THE devices and methods for the collection of sweat thus far improvised are somewhat complex In addition there are many extraneous forces which might influence the collection For example, sweat collected from an individual placed over a rubber sheet is subject to contamination by secretions other than those from the skin An arm surrounded with a jacket subjects the part to abnormal production Sucking up sweat by a syringe is cumbersome and although it is of little value for quantitative estimation, good qualitative results are obtained

The author proposes other means and methods for the collection of sweat for qualitative and quantitative estimation It is our opinion that the perspiration of an individual is a very important factor in his well-being and that any practical method for the collection and estimation of the amount secreted in the various parts of the body should have great prognostic and diagnostic value First, however, it is necessary that the method be simple and accurate and furthermore, that the apparatus be so constructed that it may be applied to any part of the body over a measured area of skin or mucous membrane The logical method of accomplishing such results presents itself in the form of a chemically inactive but efficient absorbent which can be placed in a cup (made of chemically inert material), the opening of which has a definite known area and which opening can be apposed to a given skin surface This cup can be constructed of varying shape and size so as to fit the site to which it is to be applied Likewise the absorbent is cut so that it fits snugly over the area In order that the quantitative results may be estimated, the absorbent is weighed before and after applying to the skin surface and the time of application noted. For qualitative estimation it is necessary to know the chemical composition of the absorbent, to extract the absorbent, test the extract qualitatively and therefrom compute the results.

It must be realized that normally the amount of sweat secreted varies with the metabolism of the individual, the construction of the skin, the part of the body, the temperature and humidity of the environs, the circulation of air, the cleanliness of the parts, the type and amount of clothing, the diet, etc We must also note that sweat will vary qualitatively and quantitatively in certain pathological conditions In addition, sebaceous glands, epithelium and the predominant type of sweat gland will influence the composition of sweat in the different parts and under different conditions In order that all factors be taken into consideration it is necessary that the cup containing the absorbent be varied in construction and that the methods be altered so as to fit the need

For the above reasons the author has illustrated the simple and altered types of cup with absorbent The cup in each case can be fastened to the skin surface by adhesive, belt, elastic or whatever means may best suit the part to which it is to be applied We first used vaccination shields, the holes of which had

Fig I

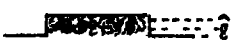


Fig II

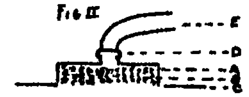


Fig III

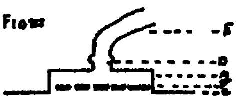


Fig IV

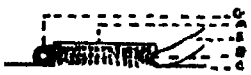


Fig V

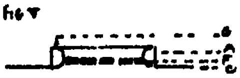


Fig VI

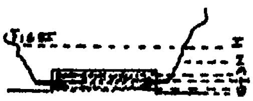
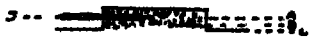


Fig VII



been closed and the shields varied to suit the occasion Specially prepared and analysed J & J. cotton was the absorbent used The absorbent was cut to the circumference of the cup and was weighed before and after application and the difference and time noted

Description of Devices

Fig I—Cross-section A is the cup, B the absorbent and C the flange which fits to the surface.

Fig II—Cross section A is the cup, B the absorbent, C the flange, D the neck of the cup and E a tube leading from the neck which can be secured to the same either by threads or other suitable means or can be made continuous with the cup The purpose of the tube E is to produce pressure or vacuum in the chamber by its being connected to a pump or other device for that purpose

Fig III—Side view A is the chamber, C the flange, D the neck of the cup, E the tube leading off from this neck and F are apertures in the side of the cup In this cup is contained the absorbent E is connected with a suction or pressure device This method produces a circulation of air in the cup because of the apertures F The cup may be constructed with an additional part so that the apertures can be closed and in that way its purpose will be identical with that of Figure II

Fig IV—Cross section A is the cup, B the absorbent, C the flange, E is a tube connected to a channelway G running around the cup and opening into the cup by means of slits The tube E can be connected with a pressure or a vacuum device so as to produce negative or positive pressure in the cup or there may be holes in the top of the cup so that a circulation of air is produced The top may be so constructed that holes in it can be opened or closed

Fig V—Side view This is a side view of Fig IV in which A is the cup, C the flange, G the channelway around the cup and F openings from it into the cup

Fig VI—Cross section A is the cup, B the absorbent, H an electrode imbedded in the absorbent and I the wires leading from the electrodes The principle of this device is to measure the conductivity through the absorbent as the perspiration is being absorbed

Fig VII—Cross-section A is the cup, B the absorbent, C the flange and J is a thermometer. The principle of the thermometer is to measure the temperature change in the absorbent In this case the cup can be made of non heat conducting material as desired

The measurement of the amount of sweat in a given length of time and from a given area under similar and varying conditions is the aim of the above devices and procedures The additional factor that the devices described are simple, easily applicable over a given area from which sweat is desired, and the estimations are not complicated should add to their practicability and assure their early usage Certainly this procedure is less complex than many which are daily routine in the well equipped hospitals of to-day In a later paper the author will discuss variation in the secretion of sweat under diverse conditions

John W Williams

Tulane University Medical School

DOUBLE PLATE METHOD USED FOR CULTURING TILLETIA LEVIS

A new procedure has been followed whereby pure cultures of *Tilletia levis* may more easily be made The bottom of a petri dish is covered with a two per cent potato dextrose agar and allowed to cool until all the moisture is gone from the top of the plate Then the top of the dish is poured with a three per cent non-nutrient agar somewhat cool The agar is poured in the center of the lid until an area about one and one half inches in diameter is covered

Streaks of sterilized smut spores are made across the non-nutrient agar with a loop needle These are then incubated for ten days at 12° to 14° C

As is well known, the sporidia of *Tilletia levis* are ejected from the sterigmata and in the double plate they fall to the nutrient agar below where they can be picked off singly or grown into multisporidial cultures free of contamination

E W Bodine

Colorado Agricultural Experiment Station,
Fort Collins, Colorado

SPECIAL ARTICLES

INBREEDING IN ALFALFA ESTABLISHES A HIGH DEGREE OF HOMOZYGOSITY[1]

A previous report[2] of alfalfa-seed investigations at the Utah Station indicated that about 2 to 2 5 times as many pods were set when artificial tripping was practiced. A considerable number of pods developed from flowers which showed no evidence of having been tripped

An inbreeding experiment of considerable proportions, the data from which are just now available[3] make clear that alfalfa in one of the famous seed-growing areas in the Uintah Basin, Utah, is much less heterozygous than has been thought As conducted, the experiment did not establish what proportion of the seed pods developed under conditions of natural self-fertilization. Although this would be difficult to do on purely positive evidence, a good beginning has been made. After generations of inbreeding, however, a study of eight different plant characters in each of 154 inbred strains, fully 50 per cent of progenies were practically homozygous for one or more of the characters. Such a degree of homozygosity makes evident a considerable amount of self-fertilization in the generations immediately preceding the self-fertilization.

---

[1] Contribution from Department of Agronomy, Utah Agricultural Experiment Station Publication authorized by director, June 15, 1931

[2] Carlson, J W., "Artificial tripping of flowers in alfalfa in relation to seed production," *Jour Amer Soc. Agron.*, 22. 780–786 (1930).

[3] Carlson, J. W, and Stewart, G., "Alfalfa-seed production," Utah Agr. Exp. Sta *Bul.* 226 (1931).

The inbreeding was brought about by putting paper bags over flowering branches of the alfalfa plant before the blossoms had opened. Branches were selected on which the tips of the blooms were well out of the bud, any flowers that were mature enough to have begun to open were clipped off, thereby enclosing in the bag only those flowers which had had no opportunity for cross-pollination. Parent plants of the following varieties were grown in rows three feet apart and with plants 27 to 40 inches apart in the row: Utah Common, Dakota Common, Grimm, Grimm Saskatchewan 666, Hardigan, and Ontario Variegated. These varieties represent a wide range in size, coarseness, leafiness, and erectness.

Seed production under bags, as a rule, is relatively poor, but in seasons moderately favorable for seed-setting, some seeds are obtained from most plants on which five to ten bags have been placed. In 1927, when the bagging was done, a few plants failed to produce any seeds under bags even when seeding well in the open air. Of approximately 180 plants so bagged, seeds were obtained from 154, of which 88 produced 50 to 100 seeds under bags. In 1928, the selfed seed from each parent plant was seeded in a single row of 50 plants when there were enough seeds. When the number of seeds obtained was fewer than 50 all of them were sown, one in a place. There were a few rows with only one to five or six plants, though in most cases 10 to 40 plants were obtained.

When these first-generation plants from self-fertilized seeds bloomed for the first time, some of them were bagged in order to produce second-generation selfed seed, from which progeny rows were seeded in 1929.

In 1929 it was observed that of the progeny grown from selfed seed, plants in some rows were variable, fully as much so as were the commercial varieties, whereas the progeny in other rows seemed to be much more uniform in erectness, in height, in diameter of stem, in size and shape of leaves and in color of blossoms and foliage. Measurements were taken of 40 plants in each of the parent rows and of all the plants in the progeny rows. Five rows of the Utah Common variety were measured—two near the breeding plats and one each from three different parts of the field but some rods away. Data were taken from each plant as to height, width, angle of erectness, diameter of a main stem three or four inches above the ground, leaflet length, leaflet width, color of the blossoms and color of the foliage. The colors were read from a standard color chart and assigned numerical values with the help of an artist. The variability of each row was computed as the standard deviation and as the coefficient of variability.

The variability of the varieties is reported in Table 1 with the variability expressed in percentage of the mean values of each character studied. Though the mean values differed widely, only the variability is reported in order to show uniformity or lack of it.

TABLE 1

COEFFICIENTS OF VARIABILITY OF PLANT, STEM, LEAF AND BLOOM CHARACTERS OF ALFALFA VARIETIES WITH 40 PLANTS IN EACH ROW MEASURED

	Percentage						
	Plant height	Plant width	Angle of erectness	Diameter of stem	Length of stem	Width of leaflet	Color of bloom Standard deviation
Utah Common	19.7	18.5	22.4	11.2	12.2	18.0	2.98
"	22.2	18.8	18.0	18.4	15.1	25.7	3.08
"	19.9	26.0	21.7	17.1	13.4	26.8	3.35
"	16.6	24.4	12.0	15.3	17.6	23.7	3.59
"	21.8	26.1	17.0	18.0	13.2	21.8	2.65
Grimm	22.9	26.9	15.0	18.8	17.2	23.6	10.80
Grimm Sask. No. 666	26.9	31.4	25.3	19.2	17.6	24.8	6.66
Hardigan	22.0	24.2	14.2	19.3	14.9	25.7	5.87
Dak. Common	21.9	25.8	7.6	16.2	12.1	21.4	2.37
Ont. Variegated	25.0	25.3	20.0	20.8	17.8	21.3	6.66

The result of one generation of inbreeding is summarized in Table 2 where the variability is reported for progenies. Comparing plant height and width in the two tables, it is clear that some of the progenies are similar in variability to the parent varieties while others are distinctly more variable and others distinctly less. This is true of each character studied, even for blossom color. There is every evidence of segregation of distinct strains of alfalfa at the end of the first inbred generation. This indication is so definite that high hopes are held for producing improved sorts after several generations of inbreeding. The second inbred generation shows rather marked tendencies to the further purification of some strains, but since these are not yet available they can be only noted here.

TABLE 2

VARIABILITY OF PROGENY ROWS OF ALFALFA, EACH GROWN FROM SELF-FERTILIZED SEED OF A SINGLE PLANT THREE PLANTS EACH OF THE HIGHEST, OF INTERMEDIATE, AND OF THE LOWEST VARIABILITY OF EACH CHARACTER

Variability group	Plant height	Plant width	Angle of erectness	Diameter of stem	Length of leaflet	Width of leaflet	Color of bloom
Highest	38.2	45.6	50.7	25.7	27.5	23.7	12.19
"	36.7	43.8	46.2	22.0	26.8	29.6	10.64
"	30.8	39.4	44.6	21.1	18.9	28.8	10.15
Intermediate	20.8	22.9	21.1	14.2	12.6	16.7	4.35
"	19.9	20.8	23.1	13.8	11.9	16.7	3.83
"	18.4	21.2	19.5	13.3	11.2	15.5	3.33
Lowest	9.3	11.0	8.6	8.5	7.1	11.2	1.22
"	9.6	11.2	7.8	6.1	6.6	10.3	1.10
"	7.9	7.5	7.0	4.5	4.8	9.0	0.0

Inbreeding which tends to purify the various subvarieties, or strains which make up a variety, allows for the appearance of any abnormalities which in open pollination (such as occurs in the field) are obscured by being in a crossed condition with normal types In the first inbred generation, three rather distinct sorts of abnormal plants have appeared

Each of two progenies, both from the same parent strain, showed several plants on which the leaflets had tiny brown markings not characteristic of any recognized disease when examined by a plant pathologist The leaves, partly folded and partly crinkled, suggested that small sections of the leaf structure had been lost or had died after development had started Sufficient study has not yet been made to enable more to be said at the present time.

In three other progenies there occurred some distinctly shorter plants extraordinarily leafy but which would produce only about half as much hay as the parent variety. One strain of nearly normal size showed in a large degree this same condition of extreme leafiness.

In a single progeny almost half the plants had the blossom replaced by a freak vegetative development that resembles somewhat the appearance of the flower buds on a plant of seed onion. This condition occurs naturally in the field at rare intervals. Here a progeny was found in the first inbred generation in which the character was thousands of times more frequent than is found in the commercial varieties or strains.

Some strains are becoming pure for erectness, while others are pure for a nearly flat position, others are showing a strong tendency to coarseness and others to a suggestion of "vininess" in the upper branches. This last character suggests a faint resemblance to twining branches such as occur on vetches and some beans

There is also considerable evidence that seeding ability in certain strains is governed in part by the genetic constitution of the plants.

While an immense amount of careful scientific work would be required to develop and maintain economic strains, the promise is such as to warrant its being given a thorough trial.

GEORGE STEWART[4]

NON-ACID-FAST TUBERCLE BACILLI

NON-ACID-FAST organisms long have been known to exist as a phase in the life cycle of the acid-fast group. Until recently no pure cultures of the non-acid-fast varieties have been obtained. It has been thought that the occasional non-acid-fast rod and the forms described as Much's granules[1] were involution forms which had lost their acid-fast property. From Kahn's recent work,[2] it would appear that these granules were the precursors of numerous young organisms. Recently Dreyer and Vollum[3] reported the cultivation of a non-acid-fast strain of human tubercle bacilli which showed optimum growth at the bottom of veal peptone bouillon medium. These organisms were fully virulent.

In this communication we describe a non-acid-fast, almost a virulent type of organism which has much in common with the acid-fast strain from which it was isolated.

A two-months-old culture of H-37 strain of human tubercle bacilli developed a group of yellow-orange, chromogenic colonies in the midst of other normal-appearing colonies These chromogenic colonies appeared to have the same morphological characteristics as the known acid-fast ones surrounding them. They were made up of numerous non-acid-fast rods and granules and were Gram-positive There were also present a few acid-fast rods and granules, and some of the non-acid-fast rods contained from one to three acid-fast granules.

Three subcultures were made at different times from the original colonies. The cultures grew rapidly, attaining a maximum growth in ten days During the first five days they were first yellow-white, then yellow, and by the tenth day they were a deep orange color Each of these subcultures had the general morphological characteristics of the acid-fast group They were composed of numerous rounded colonies, and occasionally one or more of these was piled on one another The edges of the growth were usually smooth and at times became indented as the growth progressed The staining characteristics were the same as the original colonies Dilution cultures were made to obtain single colonies After dilution growth appeared in two days This was in the form of white, rounded colonies which did not start to assume the yellow color before the fourth or fifth day By the tenth day they had attained a maximum growth and a deep orange color The rounded colonies, by the third or fourth day, showed from two to five lobulations which gave the appearance of dividing starfish eggs None of these showed the crusting projections found in many of the colonies of the acid-fast group All appeared on the surface of the medium and did not cause lysis of it By the end of the sixth week each colony had developed a fine, veil-like growth, orange in color about its base These were very similar to those seen about the bases of many single colonies of acid-fast organisms At the tenth day, sixth week and third month the organisms stained the same as those of the original colonies, except that there were fewer acid-fast rods to be found

---

[4] Formerly Agronomist, now Senior Ecologist, Intermountain Forest and Range Experiment Station, U. S. Forest Service.

[1] H. Much, *Beitr. z Klin. d. Tuberc.*, 8, 85, 1907.

[2] M. Kahn, *Amer. Rev Tuberc*, 20, 150, 1929

[3] G. Dreyer and R. L. Vollum, *Lancet*, 220, 1015, 1931.

The organism grew easily and rapidly on blood agar, it made almost a complete growth in five days, and showed no further growth after ten days On this medium it had lost its chromogenic power and appeared as dirty white, slightly heaped-up colonies. Often these had a moth-eaten appearance and irregular borders They had about the same appearance on plain agar, although some piled up in clean white, rounded groups On these media they were entirely non-acid-fast and were of a coccoid, granular type, slightly larger than ordinary cocci, although a few rods the size of acid-fast organisms still were present.

The organism gave a luxuriant growth on Long's medium It formed a pellicle on which rounded, granular, light-orange colonies developed Many of these granular colonies sank to the bottom of the flask, but others developed in their place on the pellicle These again were almost wholly non-acid-fast rods, although a few acid-fast granules were present. The growth was less luxuriant on plain and dextrose broth, and in these two types of medium it was found at the bottom of the tube as a dirty white precipitate. Growths of this sort were made up of the non-acid-fast, coccoid granular organism.

Five guinea-pigs were inoculated with suspensions of the second generation of the chromogenic organism. Each pig was given 1/50 of 1 mgm subcutaneously in the right groin Four weeks after this inoculation, all were in excellent condition and were reinoculated with 1 mg of the same culture This was again given subcutaneously in the right groin

Of these five animals, two at autopsy had no demonstrable tuberculosis The other three had caseous nodes at the sites of inoculation and varying numbers of tuberculous lesions in spleens, livers and lungs Acid-fast rods were demonstrated in smears from the caseous material, as well as in smears of the affected organs The amount of tuberculosis each animal had was much less than would be expected following a much smaller dose of our parent strain of H-37 human tubercle bacilli

We believe that this organism is a non-acid-fast mutant of our strain of H-37 human tubercle bacilli Although chromogenic, it maintains cultural characteristics similar to the acid-fast group when grown on special media Its growth on simple media is composed almost entirely of non-acid-fast granules Granular forms may be the primary type of organisms of the acid-fast group, with the chromogenic organism as an intermediate phase, and the acid-fast bacillary forms the typical, well-known varieties.

We also have evidence that sterile Berkefeld filtrates of cultures of the chromogenic organism will cause normal cultures of human and bovine tubercle bacilli and timothy grass bacilli to lose their acid-fastness and grow as forms similar to the coccoid granular type of the chromogenic mutant

FRANKLIN R MILLER
THE LABORATORIES OF THE
ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH,
NEW YORK

BOOKS RECEIVED

FISHER, ALBERT K and ALEXANDER WETMORE *Report on Birds Recorded by the Pinchot Expedition of 1929 to the Caribbean and Pacific* Pp 66 Illustrated. Smithsonian Institution.

GRINTER, L E *Design of the Reinforced Concrete Road Slab* Pp 88 12 plates. 19 figures Texas Engineering Experiment Station

JENSEN, H R. *The Chemistry Flavoring and Manufacture of Chocolate Confectionery and Cocoa.* Pp. xvi + 406. 23 illustrations. Blakiston's

MICHIGAN STATE BOARD OF AGRICULTURE. *Sixty-ninth Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan and Forty-third Annual Report of the Experiment Station from July 1, 1929 to June 30, 1930* Pp 264 The Board

PAUL, J W., H TOMLINSON and S J CRAIGHEAD. *Roof Support in Coal Mines in the Irwin, Greensburg and Latrobe Basins, Westmoreland County, Pennsylvania.* Pp 77. 17 figures. U. S. Bureau of Mines.

TRAVIS, LEE E. *Speech Pathology* Pp. xxxiv + 331. 70 figures. Appleton. $4.00.

SCIENCE

Vol 74 FRIDAY, OCTOBER 9, 1931 No 1919

The British Association for the Advancement of Science
A Hundred Years of Evolution PROFESSOR E B POULTON 345

Scientific Events
The International Geological Expedition, Industrial Research in the Nation's Industries, The New Engineering Building at the University of Wisconsin, The Canal Zone Experiment Gardens, The National Arboretum 360

Scientific Notes and News 363

Discussion
A New Mathematical Review DR G A MILLER *On the Improvement of the Dictionary* PROFESSOR NELSON W TAYLOR *Terraces in the Connecticut Valley* DR RICHARD FOSTER FLINT 366

Scientific Apparatus and Laboratory Methods
A Modification of the Osborne Mendel Salt Mixture DR PHILIP B HAWK and DR BERNARD L OSER *A Stain for Fibrin, Gram Positive Bacteria and Basal Bodies in Tissues* HELENE MYNCHENBERG WALLACE 369

Special Articles
An Ovo Testis in the Yellow Perch (Perca Flavescens) PROFESSOR C L TURNER *The Cultivation of Vaccine and Other Viruses in the Chorio Allantoic Membrane of Chick Embryos* PROFESSOR ERNEST W GOODPASTURE, ALICE M WOODRUFF and G J BUDDINGH 370

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

A HUNDRED YEARS OF EVOLUTION[1]

By Professor E B POULTON

HOPE PROFESSOR OF ZOOLOGY, UNIVERSITY OF OXFORD

THINKING over the subject of this address, I have been encouraged by a metaphor given me by Oliver Wendell Holmes at a delightful dinner of the Boston Saturday Club in January, 1894—"Memory in old age is a palimpsest with the records beneath standing out more clearly than those above" And, indeed, memories of my first British Association, at York in 1881, are clearer than those of many in later years It was a great meeting, as befitted the fiftieth anniversary, and nearly every sectional president had been a president of the association It also marked a turning-point in evolutionary controversy, being, I believe, the last meeting at which opposition was offered to evolution as apart from its motive cause or causes From 1881 onwards the battles in this section have been over Lamarckism and natural selection and their factors, especially heredity, over the size of the steps and the rate of progress Evolution itself has been generally accepted It was different at York in 1881 Dr Wright's indignation, when the reptilian affinities of *Archeopteryx* were explained in the geological section, was stirred by the hated doctrine which gave meaning and life to the demonstration I well remember, too, how Professor O C Marsh, discussing one of the meetings in this section with a young and inexperienced naturalist, said that he had felt rather anxious about the way in which his paper on the Cretaceous toothed birds of America would be received by the president, Sir Richard Owen His fears were, however, groundless, and all was well

The difference between the controversies raised in the first and the second of these half-centuries of evolution reminds us that long before Darwin saw his way to an explanation of evolution he was satisfied that evolution was a fact, reminds us, too, that we are celebrating another great centenary, for he sailed in the *Beagle* on December 27, 1831, thus entering upon the five years' voyage which, in his own words, "was by far the most important event in my life, and has determined my whole career"—the voyage which provided him with the evidence that evolution is a fact The idea of natural selection as a motive cause did not come to him until October, 1838, just two years after his return

---

[1] Address of the president of Section D—Zoology, British Association for the Advancement of Science, London, September, 1931.

The independent discovery and publication of the principle of natural selection by Dr W C Wells[2] in 1818 and by Patrick Matthew in 1831 followed a very different course, for neither of these men realized the significance of the idea which had come to him Wells wrote that he had ventured to expound it, "though at the hazard of its being thought rather fanciful than just," and Matthew half apologizes for the amount of space which has been taken from his main subject He was, nevertheless, anxious to claim credit when, twenty-nine years later, the importance of the discovery was revealed to him in the *Gardener's Chronicle* reprint of the *Times* review of the "Origin," the review of which Huxley said, "I wrote it, I think, faster than I ever wrote anything in my life" It is interesting to speculate upon what might have happened if the author had called his book "Arboriculture and Naval Timber" instead of the more severely technical "Naval Timber and Arboriculture", for, with the former title, the work might well have been consulted by Darwin who would have been led by the table of contents to discover its significance

Robert Chambers' "Vestiges of the Natural History of Creation," which appeared in 1844, undoubtedly includes illuminating thoughts far in advance of the time Thus, more than once, the author writes of organic life "pressing in" when suitable conditions arose, "so that no place which could support any form of organic being might be left for any length of time unoccupied," and he also speaks of withdrawals when the appropriate conditions pass away. Then, too, Anton Dohrn's "Functionswechsel" is foreshadowed in the conclusion that "organs, while preserving a resemblance, are often put to different uses For example the ribs become, in the serpent, organs of locomotion, and the snout is extended, in the elephant, into a prehensile instrument" And, contrasted with this, the author points to the performance of the same functions by "organs essentially different," and then to the consideration of rudimentary structures and the recognition that "such curious features are most conspicuous in animals which form links between various classes" Of great interest, too, is the forcible rebuke administered to those who maintain that an animal origin for man is a degrading thought

It was a credulous age and we need not be astonished at the author's belief in a spontaneous, or as he preferred to call it, "aboriginal," generation of clover in waste moss ground treated with lime, and his opinion that an explanation based on the presence of dormant or transported seed was "extremely unsatisfactory", or, again, his acceptance of the hypothesis, held by some authorities at the time, that parasitic entozoa were produced from "particles of organized matter" within the host, such a development being, he considered, "in no small degree favorable to the general doctrine of an organic creation by law" The authorship of the "Vestiges" was revealed in Alexander Ireland's introduction to the 12th edition, published in 1884, thirteen years after Chambers' death The secrecy appears to have been mainly due to a rule, laid down in the Chambers' publishing business, that "debatable questions in politics and theology" should be avoided

I have devoted some little time to the "Vestiges," which I think has hardly received its due, although Darwin fully acknowledged its importance in preparing many minds for a belief in evolution We know, too, that the author warmly supported the Darwinian cause in the controversy which arose over the "Origin," and that it was his advocacy which rendered possible the great encounter at Oxford in 1860, for when Huxley told him that he did not mean to attend the meeting of the section on June 30—"did not see the good of giving up peace and quietness to be episcopally pounded," "Chambers broke into vehement remonstrances, and talked about my deserting them So I said, 'Oh! if you are going to take it that way, I'll come and have my share of what is going on'" And after the meeting, J R Green wrote to his college friend, Boyd Dawkins—"I was introduced to Robert Chambers the other day and heard him chuckle over the episcopal defeat."

Owing to the kindness of Lady Boyd Dawkins and Dr Leonard Huxley, I am able to print a very interesting and hitherto unpublished letter in which Huxley confirmed the well-known description of the debate given by Green

4 Marlborough Place,
Abbey Road, N W
June 11, 1883

My dear Boyd Dawkins,

Many thanks for the extract from Green's letter His account of the matter appears to me to be accurate in all essentials, though, of course, I can not be sure of the exact words that were used on either side

It is curious that your letter should have reached me this morning, when in a couple of hours I shall start for Cambridge for the purpose of delivering the Rede Lecture on the subject of "Evolution." I should not have chosen this topic of my own mere motion. But I found that nothing else would satisfy the expectations of Cambridge! Truly "the whirligig of time brings its revenges."

---

[2] Wells, like Matthew and Chambers, was a Scotsman He was born (May 1757) of Scottish parents in Charlestown, South Carolina In the troubled times preceding the Declaration of Independence his father, to quote his own words, "*obliged me to wear a tartan coat, and a blue Scotch bonnet, hoping by these means to make me consider myself a Scotchman. The persecution I hence suffered produced this effect completely.*"

I am,
Yours very sincerely,
T. H. Huxley

Robert Chambers' work appears to have provided the stimulus which led to the preparation of an interesting and surprising manuscript[8] by the younger J. Searles Wood. It was found by my friend, Sir Sidney Harmer, among his father's papers, and bears a note, dated 1866 and signed J. S. W., Jr., stating that it "was written about 1848 or 1849 and the pencil alterations made at the time." The paper, however, bearing a water-mark of 1850, supplies a rather comforting correction, for the author was not born until 1830, and at eighteen or nineteen must have been a very precocious youth to have written such a manuscript. Searles Wood, who was a great admirer of Lamarck, was evidently stirred by the immense success of the "Vestiges" and doubtless especially by the statement that the hypothesis of the French naturalist "deservedly incurred much ridicule, although it contained a glimmer of truth." The manuscript is, however, far more than a defense of Lamarck: it contains powerful arguments in favor of evolution, based upon the very grounds which convinced Darwin himself—the "wonderful relationship in the same continent between the dead and the living," and between island species, especially in the Galapagos, and those of the nearest continental area. It will be remembered that Darwin's pocket-book for 1837, referring to this very evidence, contains the words, "These facts (especially latter) origin of all my views." At the side of a page on which the argument on island life is developed, Searles Wood had noted—"When I wrote this, Mr. Darwin had not broached his hypothesis and was not known to be any other than a believer in creation. J. S. W. Jr. 1866." Darwin's "Journal" was first published in 1839, the second edition in 1845, but I have not heard of any reader except Searles Wood who recognized, before the appearance of the Darwin-Wallace Essay and the "Origin," that organic evolution was an irresistible conclusion from the facts recorded by the author. Other important arguments, brought forward in the manuscript, will, I am sure, be read with the utmost interest when it appears in the Linnean proceedings.

A curiously interesting event in 1858, the year of the Darwin-Wallace Essay, was the appearance of "Omphalos," so well described, with the eager expectation and bitter disappointment of its author, in Sir Edmund Gosse's "Father and Son." It is unnecessary to repeat on this occasion the often told and never-to-be-forgotten story of the Joint Essay and the Linnean Society's celebration of its fiftieth anniversary, when Wallace protested in noble and inspiring words against the undue credit which he considered had been allotted to him for his share in the discovery of natural selection—a discovery brought to him, as it was brought to Darwin, by the reading of Malthus "On Population."

The effect of the Darwin-Wallace Essay upon Canon Tristram and the appearance, a few weeks before the "Origin," of his paper on the ornithology of the Sahara was brought before this section by Professor Newton at Manchester in 1887, and by the author himself at Nottingham in 1893. It is, however, desirable to emphasize its significance afresh in view of recent attempts to throw doubt on the value of concealing coloration in desert areas. Tristram was led to a belief in natural selection when he read the Essay in the light of a recent experience of many months in the Algerian Sahara, where he had observed that "the upper plumage of every bird, . . . and also the fur of all the small mammals, and the skin of all the Snakes and Lizards, is of one uniform isabelline or sand colour," and had come to realize the absolute necessity for the vast majority of the species to be thus concealed upon the uniform surface of the desert. Precisely the same necessity had been recognized in South Africa nearly half a century earlier by Burchell, when he observed the protective resemblance of a *Mesembryanthemum* and a grasshopper to pebbles, and the defensive value of thorns and acrid secretions in a bare dry country "where every juicy vegetable would soon be eaten up by the wild animals." Burchell's mention of plants with an "acrid or poisonous juice" suggests the meaning of the conspicuousness of the relatively few black, slow-moving insects which have been thought to throw doubt upon the whole theory of protective coloration in the desert. The problem is complex and the struggle for existence is waged in many ways, important among them being the physiological adaptations by which the imperative need for moisture is satisfied—a subject on which much light has been thrown by P. A. Buxton.

Coming now to the meetings of the British Association and of this section in the second half-century, we are naturally led to the discussion, "Are Acquired Characters Hereditary?" at Manchester in 1887, when Weismann, Ray Lankester, Hubrecht and many others spoke; and to the same subject at Newcastle in 1889 when Francis Galton and Fairfield Osborn, our welcome guest to-day, took part in the debate.

It was only natural that Weismann's conclusions should rouse intense opposition, for they undermined the foundations on which so much evolutionary theory had been erected. I remember Sir William Turner's words at one of our meetings about this time—"Whoever believes that acquired characters are not transmitted looks upon life with a single eye"—not in the Biblical sense, but implying monocular vision, also Lawson Tait's dogmatic statement at a meeting of the Midland Institute at Oxford in 1890, that a believer in Weismann's conclusion "says that the sun shines black" One result of the new doctrine—the collapse of Herbert Spencer's "Synthetic Philosophy," so largely built upon Lamarckian principles—was especially distressing to those who remembered a beneficent power in teaching the world to think, remembered, too, what it had done for themselves in earlier years But not all naturalists were startled and amazed when Weismann "awoke us from our dogmatic sleep" I well remember Ray Lankester's reply when I first mentioned the subject to him—"I believe Weismann is right I have always doubted the statement that acquired characters are transmitted" And his two old Oxford friends, H N Moseley and Thiselton-Dyer, were also ready to follow Weismann from the first Two sayings of Weismann may be recalled here—how the "Continuity of the Germplasm," the theory which first led him to doubt the accepted views on heredity, came to him when he discovered that "there was something which had to be carefully preserved" throughout the development of a hydrozoon, *viz*, that unexpended portion of the parental germ-cell which will give rise to the germcells of the offspring Shielded and "carefully preserved" as was this carrier of hereditary qualities, how improbable was the conclusion, that it would be effected by the happenings in distant parts of the organism, how doubly improbable the supposition that the effect would reproduce the result of these happenings in the offspring All this is, of course, well known, but it is interesting to recall it as told by Weismann himself His other remark was to the effect that if acquired characters could be transmitted, we should not be obliged to search for the evidence It would have been obvious everywhere

---

[8] Presented by Sir Sidney Harmer, F.R.S., to the Linnean Society of London. It is hoped that the manuscript will be published in the Proceedings of the Society when the rather difficult task of editing has been completed.

Although, as my friend and colleague, Professor Goodrich, has written—"these conclusions of Weismann are the most important contribution to the science of evolution since the publication of Darwin's "Origin of Species,"[4] it was soon realized that the statement of the problem required revision and that Weismann's terms "Blastogenic" and "Somatogenic" were inaccurate, for the germinal or inherent characters are no less dependent on external causes than the somatic or acquired characters This criticism was developed by Adam Sedgwick in his address to this section at Dover in 1899 and by Goodrich at Edinburgh in 1921, also, between these two addresses, by Archdall Reid. Furthermore, in the spring of 1890, when I was giving a course of university extension lectures on "Evolution and Heredity" at Gresham College, the same idea was expressed in an answer written by one of the students I was very fortunate in my audience, which included Professor A G Tansley, F R S, Wilfrid Mark Webb and W Platt Ball[5] The last-named student, in one of his answers, wrote to the following effect, if I may trust a memory of over forty years—"Acquired characters are due to external causes acting upon inherent potentialities, inherent characters are due to inherent potentialities acted upon by external causes" The distinction, which seems at first sight difficult and confusing, is very clearly shown by a simple diagram given by Professor Goodrich,[6] who considers that the expression "acquired character" should be dropped Its history is, however, so interesting—Erasmus Darwin (1794), Lamarck (1809), Prichard (1813)—and its use still so general that we may hope for its continuance, considering especially the vital importance in every-day life of the facts which it describes It is difficult to imagine Johannsen's term—"phenotype"—replacing it in discussing the problems of education or crime

In mentioning the name of the illustrious anthropologist, James Cowles Prichard, I may remind the section that the non-transmission of acquired characters was maintained by him in the second edition (1826) of his great work, "Researches into the Physical History of Mankind"[7] I have recently studied the first edition (1813) and find that the same conclusion was affirmed at this earlier date Thus, on page 195, the author states, "the changes produced by external causes in the appearance or constitution of the individual, are temporary, and in general acquired characters are transient and have no influence on the progeny" Again, on page 232, arguing that age-long exposure to heat did not cause the dark color of tropical races, he continues "and this fact is only an instance of the prevalence of the general law, which has ordained that the offspring shall always be constructed according to the natural and primitive constitution of the parents and therefore shall inherit only their connate peculiarities and not any of their acquired qualities"—a very remarkable statement to find in a book published eighteen years before the first meeting of the British Association I must also mention on this occasion the paper[8] contributed to the second meeting at Oxford in 1832, in which Prichard contends, in opposition to Cuvier, "that the various tribes of men are of one origin"

---

[4] "Living Organisms," Oxford, pp 50, 51, 1924

[5] Author of "The Effect of Use and Disuse," "Nature Series," London The excellent term "Use-inheritance" to signify "the direct inheritance of the effects of use and disuse in kind," was suggested in this book

[6] *Ibid*, p 54 See also p 62, n 1

[7] *Science Progress*, April, 1897 Reprinted in *Essays on Evolution*, Oxford, 1908

[8] *Abstract of a Comparative Review of Philological and Physical Researches as Applied to the History of*

The rediscovery of Mendel's work—epoch-making although the birth of the epoch was long delayed—produced an immense effect on the papers and discussions in this section Much of the controversy in the first and second decades of this century arose out of the belief that only large variations—or as they were called, "mutations," using an old word with a new meaning—are subject to Mendelian inheritance, and to the related belief that small variations are not inherited at all But towards the end of this period the foundations of the controversy vanished, for as Professor H S Jennings[9] pointed out in 1917, the work of W E Castle and T H Morgan proved that the smallest characters are hereditary, so that "the objections raised by the mutationists to gradual change through selection are breaking down as a result of the thoroughness of the mutationists' own studies" To give a single illustration--between a red-eyed and a white-eyed fruit-fly (*Drosophila*) seven gradations of color intervene, each of them "heritable in the normal Mendelian manner" Furthermore, in the middle member of this series, "Bridges has found seven modifying factors, each of which alters its intensity and gives rise to a secondary grade of color Now each [all] of these modifying factors are described 'specifically as mutations, as actual changes in the hereditary material'" The author finally concludes that "Evolution, according to the typical Darwinian scheme, through the occurrence of many small variations and their guidance by natural selection, is perfectly consistent with what experimental and paleontological studies show us", indeed, it appears to him to be "more consistent with the data than does any other theory," a conclusion confirmed by Dr R A Fisher's recent work, "The Genetical Theory of Natural Selection" Mendelian heredity also provided an effective answer to a difficulty by which Darwin had been greatly troubled—the supposed "swamping effect of intercrossing" on which Fleeming Jenkin had written a powerful article[10] Moreover, it can not be doubted that Mendelian research, by demonstrating the paramount importance of germinal qualities, played a great part in promoting the general acceptance of Weismann's teaching.

A mistaken belief prevailed in the early years of the Mendelian rediscovery that a new theory of evolution had been revealed to the world and that Darwinism had been abandoned The true position was emphatically stated by Miss E R Saunders at the Cardiff Meeting in 1920—"Mendelism is a theory of heredity, it is not a theory of evolution."

I need not dwell upon the paleontological evidence for continuous evolution, as Professor Osborn is here and we shall soon have the pleasure of listening to one who can tell us of the conclusions to be inferred from the matchless record of past ages in the great museum of which he is the director

The important subject of geographical races or subspecies will be discussed next Tuesday, and I will now only refer to the splendid work of the Tring Zoological Museum under the guidance of Lord Rothschild, Dr Hartert and Dr Jordan, and the conclusions published in their journal in 1903[11] "Geographical varieties represent various steps in the evolution of daughter-species", and "whoever studies the distinctions of geographical varieties closely and extensively, will smile at the conception of the origin of species *per saltum*"

The age of the earth, as estimated by Lord Kelvin and Professor Tait, was one of Darwin's "sorest troubles" "I should rely much on pre-Silurian times," he wrote in 1871, "but then comes Sir W Thomson, like an odious spectre" Lord Salisbury's treatment of this subject in his address at Oxford in 1894 will be remembered by many Entirely accepting the fact that Darwin had "disposed of the doctrine of the immutability of species," he ridiculed the demands which evolution by natural selection makes upon the bank of time "Of course if the mathematicians are right, the biologists can not have what they demand If, for the purposes of their theory, organic life must have existed on the globe more than a hundred million years ago, it must, under the temperature then prevailing, have existed in a state of vapor The jellyfish would have been dissipated in steam long before he had had a chance of displaying the advantageous variation which was to make him the ancestor of the human race" I venture to refer to this difficulty, although a difficulty no longer, because it provides a good illustration of the help which so often comes to us at these meetings, and also recalls a vigorous personality, our kindly treasurer for many years, Professor John Perry. Walking together on the Sunday of the Leeds Meeting in 1890 he explained to me the evidence on which Thomson and Tait had relied, and said that he believed the argument founded on the cooling of the earth to be sound. When, however, he heard Lord Salisbury's address four years later, and decided to re-examine the evidence, he soon discovered that an important consideration had been overlooked.

---

the Human Species The abstract occupies fifteen pages of B A Reports, vol i (including the first two meetings)

[9] *Journ. Washington Acad Sci*, vol vii, No 10, p 281, May 19, 1917, *American Naturalist*, vol li, p 301, May, 1917 The statements here reproduced are quoted from a brief summary of these two papers in *Proc. Ent. Soc Lond.*, 1917, p. lxxxv

[10] *North British Review*, June, 1867

[11] *Nov Zool.*, vol x, p 492, 1903

With his kind help I chose this subject, together with the biological evidence for the age of the habitable globe, for my address at Liverpool in 1896 In the following year as we were traveling across Canada after the Toronto meeting and the chance of collecting insects for a few minutes at each station could not be resisted, Lord Kelvin said to his wife "My dear, I think we must forgive Poulton for thinking that the earth is so very old when he works so hard *in one day* out of all the endless millions of years in which he believes!" A quarter of a century later "The Age of the Earth" was the subject of a joint discussion at Edinburgh, when the Thomson-Tait limitation of time was abandoned in consequence of researches on radioactivity

We now come to biological criticisms of evolution by natural selection, especially those urged by my friend Sir John Farmer in his presidential address to the botanical section at Leicester in 1907,[12] and concisely restated in 1927[13] In the latter publication the theory of evolution as it was held forty years ago, and, I may add, very nearly as it is held to-day, was described as "the notion that the basis of evolutionary change in living forms lay in the gradual summation of almost imperceptibly small variations, and that, in fact, specific change was attributable to selection and accumulation of these small variations as the result of environmental conditions" Except for the implied restriction of selection to "almost imperceptibly small variations," the statement appears to express fairly the opinion of many believers in natural selection at the centenary of the British Association One *main* criticism of this belief was that it led to "the facile teleology, which, like a noxious weed, had overgrown the solid framework of evolutionary doctrine" But this was not a necessary nor, in my opinion, a common result of the evolutionary beliefs of those years Let me give two examples of teleological interpretations offered forty years ago, interpretations which are anything but "noxious weeds," being extremely interesting in themselves and pointing directly to further researches and a further strengthening of the "solid framework"

On his return from a visit to Ceylon and Southern India in 1889 and 1890 Sir John Farmer gave at Oxford a most interesting lecture on his experiences I recall two of his observations which have always seemed to me most illuminating One concerned a *Loranthus,* which is so successful that it threatens the very existence of certain introduced trees It possesses a viscid fruit which adheres to stem and leaves, then from the seed the embryo puts out a sucker borne at the end of a rather thick stalk which curls down and fixes itself to anything it touches. The stalk then straightens and the fruit, containing the germinating seed, is borne aloft If, however, as he believed, the sucker becomes attached to an unsuitable surface, the stalk bends over again and makes another attempt to reach a living structure which can be penetrated, and if this fails the process continues, causing the fruit to travel in search of favorable opportunities, naturally denied to those which he often saw thickly covering the telegraph wires in the Nilgiri Hills[14]

The second observation was made upon flowering plants which depend for cross-fertilization on insect-visitors and the honey which attracts them Such flowers are well known to be robbed by insects which bite their way in and steal the honey without doing their work Now Sir John Farmer observed that in certain species this difficulty was met by the development, on the outside of the flower, of special glands attractive to a bodyguard of ants so that the lazy visitors would be compelled to seek the proper entrance and the thieves driven away. This observation has always seemed to me especially significant, as showing how the simple operation of natural selection may simulate a rather elaborate process of reasoning We may wonder whether it would have satisfied the zoologist of whom Darwin wrote to Lyell "Dr Gray of the British Museum remarked to me that '*selection* was obviously impossible with plants! No one could tell him how it could be possible!' And he may now add that the author did not attempt it to him!"

But if either or both of these interpretations should be disproved, if the ants in these and other analogous associations should be shown, as some believe, to be parasites doing no useful work for the plant—what then? Well, once again hypothesis will have played a fruitful part in stimulating and guiding research

An often repeated objection to natural selection is the difficulty or impossibility of accounting for the earliest stages of useful structures It is, of course, unwise to attempt an explanation of an unknown origin We can only await further discoveries, and oftentimes admit that there is little hope of success But the difficulty is frequently completely met by Anton Dohrn's principle of "change of function." A new function is often taken over by an organ adapted to perform another, the two at first overlapping and the younger gradually supplanting the older. The various uses of vertebrate limbs supply a good illustration

Another valuable principle, working in association with Anton Dohrn's, is the "Organic Selection" of Mark Baldwin, Lloyd Morgan and Fairfield Osborn. The power of individual adaptability "acts as the nurse by whose help the species . . . can live through times in which the needed inherent variations are not forthcoming." But this power of adaptability is itself a product of selection. "The external forces which awake response in an organism generally belong to its inorganic (physical or chemical) environment, while the usefulness of the response has relation to its organic environment (enemies, prey, etc.). Thus one set of forces supply the stimuli which evoke a response to another and very different set of forces."[15]

---

[12] An answer to the criticisms in this address appeared in the Introduction to *Essays on Evolution*, Oxford, p xliv, 1908

[13] *Proc Roy Soc*, B, vol 101, pp i, ii, 1927

[14] My friend has kindly refreshed my memory on some of the details.

What other theories of evolution have been offered to us by those who would reject or limit the power of natural selection? Some of them have been mentioned by a writer in a recent number of *Nature*[16]—"orthogenic variations," "established organic architecture," "metabolic routine," "laws of growth" and "conditions of organic stability." Others were named in Sir Peter Chalmers Mitchell's Huxley Memorial Lecture in 1927, and I agree with his description of them as a "brood of imaginary vital forces, gods placed in machines to account for modes of working we do not understand", although, in many instances, some supposed manifestation of an internal developmental force receives a ready explanation along the lines suggested by H. W. Bates in his classical paper.[17]

> The operation of selecting agents, gradually and steadily bringing about the deceptive resemblance of a species to some other definite object, produces the impression of there being some innate principle in species which causes an advance of organization in a special direction. It seems as though the proper variation always arose in the species, and the mimicry were a predestined goal. [Then, after mentioning other suggested hypotheses, he concludes that all are] untenable, and the appearances which suggest them illusory. Those who earnestly desire a rational explanation, must, I think, arrive at the conclusion that these apparently miraculous, but always beautiful and wonderful, mimetic resemblances, *and therefore probably every other kind of adaptation in beings*,[18] are brought about by agencies similar to those we have here discussed.

The writer in *Nature* who marshalled his array of supposed developmental forces contrasted with them "the old nightmare view of evolution as a chapter of accidents." Well, a nightmare is not uncommon as a result of imperfect digestion!

The concluding section of the address will be almost entirely devoted to recent work with a direct bearing on Darwinian evolution—the researches upon mimicry and allied subjects undertaken by a band of brother naturalists widely scattered over the world. My greatest scientific interest and delight have been found in this work, and to it for nearly fifty years all available time has been given. The preparation lies far back in childhood, for my earliest memories are of living insects, and then at a fortunate period I read Professor Raphael Meldola's translation, with his valuable notes, of Weismann's "Studies in the Theory of Descent." He soon became my dear friend, and for nearly a quarter of a century I relied "probably even more than I am myself aware upon his sympathy and help."[19]

I would ask any naturalist who feels inclined to criticize the amount of space given to insect-mimicry in this address, to remember the words of H. W. Bates—"The process by which a mimetic analogy is brought about in nature is a problem which involves that of the origin of all species and all adaptations."[20]

The evidence for evolution by natural selection to be briefly described is in large part associated with the name of Fritz Muller, the illustrious German naturalist of whom Sir Francis Darwin wrote—"The correspondence with Müller, which continued to the close of my father's life, was a source of very great pleasure to him. My impression is that of all his unseen friends, Fritz Muller was the one for whom he had the strongest regard."[21] These words enable us to realize the special value and interest of Darwin's letters to Fritz Muller, the noble gift which the British Association has received within the last few months from Professor Fairfield Osborn.

Many of Fritz Muller's letters on insect mimicry and allied subjects were sent by Darwin to Professor Meldola, who communicated the observations to the Entomological Society of London,[22] of which he was an honorary secretary.

Whenever I have brought some striking example of insect mimicry to Sir Ray Lankester, my dear friend and the friend of many here, his comment was always the same—that it was a convincing proof of evolution by natural selection, and that he was unable to understand how any naturalist could come to a different conclusion. And yet, as we know, many have done so and probably many do so still. I hope, therefore, that it may be interesting and perhaps convincing to some unbelievers to refer to the two plates recently published in the Transactions of the Entomological Society[23]

---

[15] Poulton in *Proc. American Assoc. for Adv. Sci.*, vol. xlvi, p. 241, 1897.

[16] Vol. 127, p. 479, March 28, 1931.

[17] *Trans. Linn. Soc. Lond.*, vol. xxiii (1862), Pt. III (1862), Mem. XXXII, p. 514.

[18] Italicised for the purpose of this address.

[19] "Essays on Evolution," p. ix. This work is dedicated to Raphael Meldola.

[20] *Ibid.*, p. 511.

[21] "Life and Letters of Charles Darwin," London, vol. iii, p. 37, 1887.

[22] Darwin's letters to Meldola, including ten referring to Fritz Müller, are printed in "Charles Darwin and the Theory of Natural Selection," Poulton, London, 1896. The originals, with many of F. Müller's letters, were presented by Professor Meldola to the Hope Library, Oxford Univ. Museum.

The moth model and butterfly mimic, beautifully illustrated on plate XIV, really speak for themselves, but it must be explained that the resemblance between the patterns is much closer on the upper surface of the wings than on the under, that the orange patch evidently becomes a conspicuous warning mark (aposeme) in which the position of rest when the insects hang with drooping wings and the under side of the body is uppermost, that the position of the mimic's patch on the parts of the wings which cover the body and not on the body itself, as in the model, is evidence of selective elimination guided by the sense of sight, also that model and mimic fly together round the tops of trees, the former being much the commoner I owe this most interesting example to my kind friend, Dr Karl Jordan, of the Tring Zoological Museum

The second example, shown on plate XV, is of a very different kind, but I think equally interesting and convincing The oval yellow masses of silk spun on the outside of their cocoons by the caterpillars of the W African Bombycid moth, *Norasuma kolga,* closely resemble the cocoons constructed by Braconid parasites which have devoured a larva or pupa The appearance is, I believe, well known to nearly everyone and is especially common in the autumn, when the dead or dying caterpillars of the Large Garden White butterfly may be seen on walls and fences, bearing the yellow cocoons of the parasitic larvae which have destroyed them It has sometimes been thought that the object of the pretended Braconid cocoons is to deceive the female *Bracon* in her search for caterpillars in which to deposit her eggs, but this is most improbable because these parasites are guided by other delicate senses in addition to sight, which perhaps is not employed for this purpose, above all, because the eggs which are the ultimate cause of parasitic cocoons like the pretended ones, would have been laid far back in the life of the victim It is probable that the conspicuous yellow color is advantageous to the parasites, for the small cocoons are very tough and contain but a small amount of food A few experiments, perhaps a single one, would teach a bird that a cocoon bearing these yellow masses contains only a shrunken skin, and also that the yellow cases themselves are not worth opening The yellow warning color is advantageous to the parasites "because enemies are all the more readily discouraged from making attempts which would incidentally lead to the destruction of some of them Hence the obvious advantages conferred by false cocoons of parasites when mistaken for real ones"[24] This interesting adaptation was discovered by my old friend, Dr W A Lamborn, O B E, who, a little earlier, had found another example in which the same deceptive resemblance was brought about in a totally different way The cocoon of another West African moth (*Dalemera antinorii*) he observed to be covered with little yellowish spheres so very like Braconid cocoons that he kept them and watched for the parasites to emerge It was finally discovered that the "cocoons" are spheres of hardened froth evacuated by the *Dalemera* caterpillar and then attached with silk to the outside of its cocoon The late Mr G F Leigh, of Durban, was similarly deceived by an allied East African species and threw away three or four cocoons, thinking they had been parasitized

What interpretation can be suggested for adaptations such as these, except the selection and accumulation of small variations? And it is to be remembered that even in the mimetic butterfly of Plate XIV the associated instinct—the attitude assumed at rest—is an essential element in the resemblance, while in the construction of the false cocoons shown on Plate XV, the instinctive actions are nearly everything It is also to be remembered that these actions are prophetic, destined for the protection of a future pupal stage This fact is so interesting and significant in its bearing on theories of evolution that I venture to bring before you two other especially striking examples, although, of course, prophetic activities are displayed by every caterpillar in spinning its cocoon or otherwise preparing for pupation

The larva of an African Tabanid fly (*T biguttatus*) lives and becomes a pupa in mud which, in the dry season, is traversed by cracks so wide that they would often expose the insect in its most helpless stage But Dr Lamborn discovered that the maggot has prepared for this danger It carves out a cylinder from the surrounding mud, making a line of weakness by means of a close spiral tunnel, then it enters just below the top of the cylinder and pupates in its center The pupa when mature bores its way through the hard mud covering and the fly emerges. Dr Lamborn was led to his discovery by observing the tops of the cylinders, of about the size of a penny, often with the pupal shell protruding from the center, also by noticing that the cracks running in all directions stopped short when they reached the cylinders. I feel sure that you will agree with the words written by Professor J M. Baldwin when he read the account of this instinctive behavior—"As to the discovery of Lamborn, it seems *complete*—one of those rare cases of a single experience being sufficient to establish both a fact and a reason for the fact! It is beautiful"[25]

---

[23] *Trans Ent Soc Lond*, vol lxxix (pls xiv and xv, 1931) The cost of reproduction has been borne by the Fund for Promoting the Study of Organic and Social Evolution, presented to Oxford University by my dear friend Professor James Mark Baldwin.

[24] *Trans Ent Soc Lond*, vol lxxix, p 397, 1931. This paper gives full references to all the observations here referred to in the description of pls xiv and xv, as well as others necessarily omitted.

The other observation is also of especial interest, being an arresting example of the attainment of the same end by a different and unusual means In leaving their cocoons some insects gnaw their way out, others make use of holes drilled by pupal spines, as in the last-mentioned Tabanid fly The well-known "Puss-moth" (*Dicranura vinula*) has been shown by O H Latter to soften the hard cocoon with a secretion of caustic potash Many caterpillars in spinning their cocoons make special provision for easy emergence and difficult entrance, on the reversed principle of the lobster-pot, a beautiful example being our own "Emperor Moth" (*Saturnia pavonia*) Now these preparations are made in spinning the cocoon, but the caterpillar of an Indian moth allied to our "Lappet Moth" first nearly finishes its cocoon and then deliberately bites two slits in it As Lt-Col F P Connor[26] has written "It was a striking fact to observe how the larva, after all but completing the cocoons, always "remembered" to destroy part of its laboriously built home by biting out two deep clefts at one end, and how the valve-like door thus made was patiently tested several times to make certain of its being of the right size, and then carefully closed on the inside with a little soft silk which would not interfere with the emergence of the imago" In testing the opening the caterpillar extended "half its body out of the cocoon to assure itself that the vent was large enough" How is it possible to apply any Lamarckian theory of inherited experience or of effort and improvement following from experience, to examples like these? The experience of ease or difficulty in emergence in the last example, of failure or success in evading enemies in the others, will come, not in the stage which made the preparation but in a later one, and should it come, the chances of handing on its lessons would be negligible. "The prime necessity for an insect, as for all animals which can not in any real sense contend with their foes, is to avoid experience of them altogether"[27] And the cocoon-making activities described above are preparations, made long beforehand, for the avoidance of experience

I propose now to refer briefly to some of the objections which have been raised against the opinion that protective and mimetic resemblances have arisen by natural selection, and to consider alternative suggestions Dr Paul Vignon, in his fine and beautifully illustrated monograph[28] on the leaf-like Long-horned Grasshoppers (*Tettigoniidae*) of tropical America, comes to the conclusion that the detailed resemblance to decayed leaves or leaves apparently mined or eaten by caterpillars, is useless, his reason being that other species with the much simpler likeness to uninjured leaves are able to hold their own in the struggle with greater success, as shown by their comparative abundance Therefore he considers the details as a "decoration" unnecessary in the life of the insect, agreeing with Brunner's theory of "Hypertely"[29] I believe, on the contrary, that the detailed resemblance to one out of many different appearances which the same object may present—*e g*, to a leaf gnawed into a particular shape by a caterpillar—would often mean safety to a rare, hard-pressed species but great danger to a common one, for the sharp senses of enemies would quickly detect the meaning of that one shape, and then a special search would be made for it[30] I am sure, however, that every one will share the author's hopes for further observations on the living insects in their natural surroundings

On the subject of the protective resemblance to leaves I can not resist the temptation to say a few words about W J. Kaye's discovery of the part played by the dead-leaf-like under surface of the tropical American butterfly *Protogonius*.[31] The upper side of this butterfly roughly resembles the conspicuous warning pattern of the predominant mimetic association of its locality, changing when the pattern changes as we pass from one area to another—always a mimic although always a poor one. At rest, with folded wings, the resemblance to a dead leaf is perfect Now Kaye observed that when the open wings of these butterflies were seen from below against the sky the appearance was that of the upper surface, so that at first he thought they must be flying upside down When, however, he examined them he found that the apparently opaque dead-leaf-like under side was completely overwhelmed by the stronger contrasts of the upper surface The wings of *Protogonius* were shown in this section at Liverpool in 1923, when a friend who does not greatly favor an interpretation based on natural selection, pointed out rather triumphantly that the dark and the light parts of the two patterns correspond respectively But this is precisely the kind of result which affords proof of evolution by selection The two patterns certainly have a common plan, but by stippling here, softening there, and the addition of delicate tints in streaks and washes, the conspicuous, strongly contrasted mimetic pattern of the upper surface is replaced on the under by a beautiful and detailed likeness to a dead leaf

---

[25] *Proc Ent Soc Lond*, vol v, p 14, 1930 Lamborn's discovery is published in *Proc Roy Soc*, B, vol 106, p 83, pl v, 1930 As this address was being written a letter arrived from my friend at Fort Johnston, Nyasaland, telling me that he has just bred another Tabanid fly, at present undetermined, from a mud cylinder like that of *T biguttatus*

[26] *Journ. Bombay Nat. Hist Soc*, vol xxvi., p 691, 1919

[27] The arguments in this paragraph were brought forward in the unpublished discussion "Are Acquired Characters Hereditary?" at the Manchester Meeting, September 5, 1887 (*Report*, p. 755). The later occasions on which they were developed and recorded are mentioned on p [illegible] of [illegible], where they are reprinted pp 117 118 15[illegible]

[28] *Arch du Mus* [illegible] V, [illegible] 1930 See also his *Introduction a la Biologie Expérimentale Les êtres organisés* [illegible] Encyclopédie Biologique, VIII, Paris, 1930

[29] Professor J M Baldwin has kindly written the following note on a subject (recalled by Dr Vignon's memoir) we had discussed together "The continued lack of enthusiasm for natural selection in France seems at first glance remarkable It seems inconsistent with the French love of logical "clearness and distinctness" given as the criteria of truth by the French philosopher Descartes, for whom his countrymen have the greatest veneration But the tendencies shown in the work of Delage and Giard in the last generation appear still in the publications of such thinkers as Le Roy and Brunschweig Naturally I take no account of special researches of younger biologists with which I am not familiar The philosophical writers, at least, retain a diluted Lamarckism, somewhat hesitant, it is true, and always on the defensive It is part of the vitalism expressed by Bergson in the terms 'élan vital' and 'évolution créatrice' The positivism of Auguste Comte is still completely demoded, except in the sociological work of Durkheim and Lévy Bruhl, in which the question of the method of biological evolution has no place The revolt against Bergsonian vitalism in the intellectual world has been directed against its mysticism, but has not extended itself to questions of biology"

[30] *Proc. Ent. Soc. Lond*, p cxlv, 1924.

Before considering the objections to the theory of mimicry it is necessary to devote a little time to Fritz Muller's interpretation of the resemblances which Bates was unable to explain His difficulty was caused by the remarkably detailed likeness between many species in the two groups which he called *Danaoid* and *Acraeoid Heliconidae,* groups really widely separated and now known respectively as the *Ithominae* and the *Heliconinae,* both conspicuous and distasteful, and providing models for other butterflies and moths, yet often mimicking each other, the *Heliconinae* being commonly mimetic, the *Ithominae* rarely Bates was referring to these resemblances in the following sentence "Not only, however, are *Heliconidae* [*viz*, both the *Danaoid* and *Acraeoid* groups] the objects selected for imitation, some of them are themselves the imitators, in other words, they counterfeit each other, and this to a considerable extent"[32] The theory of mimicry which bears Fritz Muller's name was suggested by him in 1879[33] Briefly, the theory rests on the advantage of a combined advertisement in saving lives that would have been lost in the experimental attacks of enemies. Batesian mimicry, on the other hand, rests on the advantage of a false advertisement, leading a palatable insect to escape because mistaken for a distasteful one Much controversy has arisen over the mathematical aspect of the problem, but this can not be considered on the present occasion I have been led to believe that Mullerian mimicry is more important than Batesian because models and mimics are so commonly found in the same presumably distasteful group, and because the resemblances which were not explained by Bates' theory are so much commoner than he supposed Thus the distasteful Heliconine butterflies, among which he recognized mimics of the Ithomiines, are also themselves divided into groups, of which one mimics the other so perfectly that the real difference was for many years unsuspected[34] And this is equally true but far more striking in the Heliconine mimics of Ithomiines because the patterns are very elaborate, so much so indeed that these mimics are among the most remarkable in the world

One or two more examples which suggest the prevalence of Mullerian mimicry may be mentioned. The intricacies of systematics being unnecessary for the appreciation of the argument, I propose to reduce them to a minimum The "White Admirals" of the northern belt have been separated into different genera, but they are all nearly related with very similar life-histories They are, except when modified by mimicry, dark butterflies with conspicuous white markings displayed in a sailing flight. In Europe they are mimicked by the female of our "Purple Emperor" and other butterflies, including a black-and-white invader (*Neptis*) from the south, this latter butterfly belonging to a group which itself provides models for mimicry Any doubt about the mimetic resemblance of the female Emperor is dispelled when we remember that numerous allies of these Admirals in tropical America (*Adelpha*) are there mimicked by females of butterflies allied to the Emperors (*Chlorippe*). In North America some of the White Admirals possess the black-and-white pattern, one (*astyanax*) is a mimic of a distasteful Swallowtail (*P. philenor*), but at the same time is considered by Scudder to be the model for a female Fritillary. Others are beautiful imitations of Danaine invaders from the Old World, and the mimicry is so recent that one of these (*archippus*) and also *astyanax* can breed with their black-and-white ancestor (*arthemis*) and produce intermediate offspring.[35] There is finally a species (*lorquini*) on the Pacific Coast which is a mimic of a southern invader (*californica*) closely related to the tropical American Adelphas This last, too, is of especial interest because the mimicry is only developed where the two butterflies overlap, and dies away to the north and east where *lorquini* spreads beyond the range of its model [36]

---

[31] *Ibid*, p xcviii, 1922, p xxxvii, 1923 See also p xl for Lord Rayleigh's notes on the optical interpretation

[32] *Ibid*, p 507

[33] *Kosmos* The paper was at once translated by Meldola and published in the *Proc Ent Soc Lond*, p xx, 1879 A preliminary paper containing everything essential to his theory of mimicry was published by Fritz Müller in *Zool Anzeiger* (Carus), I, pp 54, 55, 1878 Translation by E. A. Elliott in *Proc. Ent. Soc Lond.*, p. xxii, 1915.

[34] W J. Kaye in *Proc. Ent. Soc. Lond*, p xiv, 1907; H. Eltringham in *Ibid., Trans*, p. 101, pls. XI–XVII, 1916.

We have seen that the Adelphas of the New World are models, but the corresponding African representatives of the White Admirals, the Pseudacraeas, are, with one or two exceptions, mimics, resembling certain Acraeine butterflies conspicuous in their localities, and in two instances Danaines, one of the models being *D chrysippus*

These tangled relationships of models and mimics in the great group of "White Admirals" and their allies are in my opinion impossible to reconcile with the Batesian theory, but in every way consistent with the Mullerian It will be necessary to return to the African Pseudacraeas, a little later, but I will first mention one more example which, I believe, supports the same conclusion

During the meeting of the Association at Toronto in 1897, I met Dr Gustav Gilson, of Brussels, who was about to visit Fiji and very kindly promised to collect butterflies for me Among the specimens received were two species of *Euploea*, one of which had obviously been modified in mimicry of the other Now the Euploeas are among the most distasteful and most commonly mimicked butterflies in the world, and I became extremely anxious to obtain more specimens from different islands of the Fijian and other groups Finally, after waiting more than twenty years I received a very kind letter from Mr. Hubert W Simmonds, who had heard of my wants, which he then proceeded to supply most generously and efficiently, enabling me to study this and other equally interesting problems There is not now the possibility of describing the results,[37] but I will mention, as bearing on the Müllerian theory, that the mimicking *Euploea* of Fiji is found to be a model on Wallis Island, and the model of Fiji its mimic; while on Fortuna Island, 150 miles away, the Wallis model is absent, while the other *Euploea* is present, but unmodified by mimicry

The year before Fritz Müller proposed his theory of mimicry in 1878, he published a paper which was probably the preparation for it—the paper in which he explained the meaning of the gregarious habit in certain distasteful insects. Thus, writing of the dull brown caterpillars of two American butterflies, he suggested that the social habits "which lead them to congregate in large numbers make up for their want of color, since their offensive odor then gives timely warning to an approaching enemy"[38] This interpretation has recently been adopted for the interesting and hitherto puzzling habits of *Heliconius charithonia*, which collects into crowded groups on bare twigs in the evening, as was first recorded by Philip Gosse in Jamaica in 1851 and since then by numerous observers *H charithonia*, which belongs to the distasteful Heliconines referred to on page 354, and is itself mimicked by other butterflies,[39] has been carefully studied by Dr F M. Jones, and its gregarious habits described in detail in his paper "The Sleeping Heliconias of Florida"[40] He here suggests that the warning characters may be rendered more effective at night "by the close proximity of large numbers, under these conditions readily recognizable by form, color, or *scent*, as identical in kind and inedible, for thus the injury or destruction of one of the group might conceivably work for the protection of the many" It may be added that the choice of leafless twigs for a resting-place obviously enhances the conspicuousness of the assemblage

We must now return to one of the African Pseudacraeas, a wide-ranging species (the Linnean *eurytus*) which subdivides into a number of local forms mimicking the local Acraeine models This species is represented in Uganda by a race (*hobleyi*) so significant in its bearing on evolution by selection that it is necessary to give a little time to it *Eurytus hobleyi* appears in three forms—two, with male and female alike, mimicking two Acraeine butterflies (*Planema*) differing in color but also with male and female alike. The third, with male and female very different, mimics a third *Planema*, the sexes resembling the corresponding sexes of the model Now these four mimetic forms —for the male and female of the last were believed to be of different species—have all been described and named as distinct, and there was great astonishment and even some incredulity when Dr Karl Jordan, relying on structural features, pronounced them to be one. After many efforts to test this conclusion by breeding, a cable was received from Dr Hale Carpenter on Bugalla Island (N W Victoria Nyanza), giving the information which proved that Dr Jordan was right.

---

[35] *Proc Ent Soc Lond*, p xciv, 1916. Abstract of W. L. W Field's three valuable papers in *Psyche*

[36] *Trans. Ent. Soc. Lond.*, p 447, 1908. *Lorquini* and its model are represented on pl. XXV, which also shows a reciprocal approach of the latter towards its mimic Owing to the kindness of Commander C M Dammers I have been provided with Mimicry in the N American "White Admirals," here very briefly summarized, is the opportunity of renewing this investigation with far more extensive material, considered in detail in the above paper and in *Proc. Acad. Nat. Sci. Philadelphia*, p. 161, January, 1914.

[37] A full description appears in *Trans. Ent Soc Lond.*, p. 564, pls. XXIX–LIII, 1928

[38] *Kosmos*, December, 1877 Translation by Professor R. Meldola in *Proc. Ent. Soc Lond*, pp vi, vii, 1878

[39] W. J. Kaye in *Proc Ent Soc Lond*, vol. v, p. 89, 1930.

[40] "Natural History," *Journ American Mus. Nat. Hist.*, vol. xxx., p 635. A full abstract, with references to other observations, in *Proc. Ent. Soc. Lond.*, vol. vi., p 4, 1931.

Many other families were then bred by Dr Carpenter, and these, with his captured specimens, showed that, in the islands, the three forms run into each other, being connected by an abundance of transitional varieties which are extremely rare on the adjacent mainland of Uganda The significance of this is obvious when it is realized that the models are for some unknown reason comparatively scarce on the islands[41]

The same conclusion is enforced by the wonderful families of *Papilio dardanus*, bred by Dr V G L van Someren and Canon K St Aubyn Rogers from localities near Nairobi Now in the families of this butterfly that have been bred in other parts of Africa—by Carpenter in Uganda, by Lamborn on the W and E coasts, by Swynnerton in S E Rhodesia, and by Leigh in Natal, the mimetic forms of the females are sharply separated—a fact which led to the mistaken conclusion that these patterns appeared fully formed and complete at once as a single variation But in the Nairobi families, as in the Pseudacraeas of the Uganda islands, all kinds of transitional forms appear and, most striking of all, the *trophonius* female mimicking the Danaine *D chrysippus* has not been bred but only its primitive ancestor *lamborni*, and this has appeared often, although very rare in other localities Here, too, the same explanation holds, for Dr van Someren and Canon Rogers have observed that for some cause, perhaps the elevation, the Danaine models are much scarcer than their mimics, and can not be supposed to influence the selective elimination as in other parts

These two striking examples offer, I believe, convincing evidence of the power of selection in the evolution and preservation of mimetic patterns, also that the evolution was by small variational steps The remarkable families of *Hypolimnas bolina*, bred by Mr H W Simmonds in Fiji, supply further evidence in favor of this last conclusion[42]

Admitting, as claimed and, I believe, proved above, that selection is essential for the evolution of mimicry, nevertheless the abundance of mimetic forms when their models are rare, and still more when they are absent altogether, does make it difficult to feel confident that natural selection, in its accepted sense of survival of the fittest, has always been the cause This doubt was first raised in my mind by the consideration of the Oriental butterfly, *Papilio polytes*, and led to the belief that in this and probably other predominant species the absence of the model finally leads to the disappearance of the mimetic pattern, "although the species that bore it remains as abundant as before The survival or extinction of the species is not affected all that has happened is the survival or extinction of a pattern borne by a certain proportion of the individuals of the species When these disappear, other individuals with another pattern take their place"[43] For this process Professor Julian Huxley has suggested the term "intraspecific selection," to be contrasted with natural selection which ensures the survival of the species in its organic environment and, therefore, in a struggle which is *interspecific* Mr A J Nicholson[44] has independently proposed a similar hypothesis but seeks to carry it much further, so as to cover all examples of mimicry and protective resemblance My reasons for disagreeing with this opinion are given in the above-mentioned paper on intraspecific selection

Certain criticisms which have been brought against the theory of mimicry have followed from the erroneous assumption that the warning colors of the models imply complete immunity from attack, even by parasites, an assumption unfortunately made by Haase in his important and valuable work[45] Of course no species enjoys absolute immunity, and if it did so the enjoyment would be brief, for it would rapidly destroy its own means of existence Furthermore we know, as my friend Dr Hale Carpenter showed to this section at Birmingham in 1913, that the species distasteful to insectivorous animals (although not by any means entirely free from this danger) are specially subject to parasitic attack At the same city, in 1886, I brought before this section the theory of a compensating principle[46] which would check the increase of distasteful insects, for when other food became scarce they too would be devoured, and then their conspicuous appearance and slow movements would lead to their easy capture This theory was supported by experiments which proved that insectivorous animals, when they are sufficiently hungry, will in fact eat the distasteful species, although often with signs of disgust The experimental method, necessarily employed in testing the above-mentioned hypothesis, and also of much value when other evidence is wanting, was criticized by W L McAtee in a paper published in 1912[47] I was probably mistaken in not at once writing a detailed reply to these criticisms, which were not only directed against the conclusions drawn from experimental feeding, but also against other conclusions on which the theory of mimicry is founded On the other hand, there was much to be said for waiting until far more evidence had been collected, and now, after nearly twenty years, it may be fairly maintained that such evidence has been forthcoming

---

[41] *Trans Ent Soc Lond.*, p 706, 1912, p 606, 1913, p 84, 1920, p 469, 1923.

[42] *Trans. Ent. Soc Lond*, pls XLV–LIII, 1923

[43] Poulton in *Proc Zool Soc Lond*, p 1037, 1928. The term "Intraspecific Selection" was introduced in this paper, which also quotes the essential passages from the paper (*Bedrock*, vol. ii, No 3, p 295, October, 1913, in which the hypothesis was first suggested

[44] "A New Theory of Mimicry in Insects," *Australian Zoologist*, vol v, pt 1, p 10, pls I–XIV, November, 1927

[45] *Untersuchungen über die Mimicry*, Stuttgart, 1891–3.

[46] Considered in detail in a paper published in the following year: *Proc Zool Soc Lond.*, p. 191, 1887.

[47] "The Experimental Method of Testing the Efficiency of Warning and Cryptic Coloration in Protecting Ani-

In the first place it may be granted that, apart from its special value as a test, the experimental method is, in this investigation, very inferior to the direct observation of attacks made upon insects by birds and other enemies in their natural surroundings and undisturbed It is impossible on this occasion to attempt to give any account of the great number of such records which have accumulated since the appearance of McAtee's criticisms I will, however, mention two sets of observations In 1927 Dr Hale Carpenter kindly sent me the wings of Uganda hawkmoths—twenty-one specimens and seven species—found on the floor of a rest-house where they had been dropped by bats hanging in the roof This interesting observation suggested an examination of moths' wings dropped by British bats—an ideal means for discovering their true preferences Wings representing 1,328 moths were collected in sheltered places frequented by bats—probably always by the long-eared bat (*Plecotus auritus*) All the specimens except sixteen belonged to species with protective (procryptic) colors and habits The exceptions included relatively conspicuous species shown by experiments on other animals to be rather distasteful (sometimes accepted, sometimes refused), also species of which the palatability is unknown Not a single specimen with a striking warning pattern was present [48]

The second series of observations is now being undertaken at Vineyard Haven, Massachusetts, by Dr Frank Morton Jones, who has kindly written to me, explaining the details of the excellent methods he is employing. Insects, chiefly Lepidoptera and Coleoptera, of known species, are exposed on a feeding-tray in a favorable locality and the visits of birds watched at a distance through field-glasses Thus on June 27 last, of 63 beetles belonging to nine species placed on the tray, there remained in 30 minutes, after 22 bird-visits (three species), 15 beetles of one red-and-black species Thus 48 beetles of eight species were taken and all the 15 of the ninth species were untouched. Dr F M Jones is also attempting to form a scale of distastefulness by observing the reactions of a common species of ant to the insects employed in the experiments.

One of the chief criticisms made by McAtee, and made in this country also, was the insufficiency of the evidence that butterflies are commonly attacked by birds, the enemies believed to be the selective agents in the evolution of mimicry McAtee, in support of this objection, quoted the results of an American agricultural investigation in which an enormous number of birds' stomachs had been examined and remains of butterflies found in only an insignificant proportion This criticism had been in great part met beforehand in a paper[49] published by Sir Guy Marshall in 1909; and more recently C F M Swynnerton[50] and W A. Lamborn[51] have conclusively shown that butterflies are rapidly reduced to such minute fragments in a bird's digestive tract that examination with the compound microscope is necessary in order to obtain trustworthy results Furthermore, it is only in recent years that the imprint of a bird's beak on a butterfly's wing has been noticed, but now that attention has been directed to this evidence it is found to be quite common—a good example of the fertile but, for the uncritical, the dangerous principle that an observer only finds what he looks for

It is possible that the mistaken assumption of the immunity of models has played a part in prompting Dr Bequaert's interesting paper on the enemies of ants [52] Admitting the existence of these enemies and the certainty that the list will be immensely lengthened, it still remains that ants are "the most powerful of insects, ever-present and aggressive in all habitable parts of the earth "[53] And it is difficult to reconcile with Dr Bequaert's opinion that they are valueless as models, the fact that my friend Mr H St J K. Donisthorpe has, since 1891, discovered, in the nests of British ants, "204 species of insects, spiders and mites new to the country, including 74 new to science Of these guests 28 are mimics of ants He has also recorded 34 mimics living independently of ants "[54] I believe that most naturalists will conclude

---

mals from their Enemies '' *Proc Acad Nat Sci Philadelphia*, pp 281–364, 1912

[48] *Proc Zool. Soc Lond*, Pt 2, p 277, 1929 The interesting plates I–III in *Proc Ent Soc Lond*, vol vi, 1931, provide evidence of the same value as that furnished by the rejected wings They show young cuckoos being fed by fosterers with ''Small Garden White'' butterflies, in Sussex, photographed by Mr H F Chittenden, and Cumberland, by Mr A G. Britten. Dr J G Myers' observations on the insect food of the Coati (*Nasua*) were also in large part made under natural conditions (*Ibid*, vol. v, p 69, 1930). See also Capt C R. S. Pitman's experiments on an African Lemur (*Perodicticus*) on p. 91, and in vol. iv., p. 90, 1929

[49] *Trans Ent Soc Lond*, p 329, 1909 See especially pp 336, 337

[50] *Linn Soc Journ Zool*, xxiii, p 203, 1919 Abstract in *Proc Ent Soc Lond*, p xxxii, 1915

[51] *Proc Ent Soc. Lond*, p xxvi, 1920

[52] *Bull Am. Mus. Nat Hist*, vol xlv, p 271, New York, 1922

[53] *Zoolog Anz* (Wasmann Festband), p 86, 1929

[54] *Ibid*, p 84 Quoted from ''Guests of British Ants,'' Donisthorpe, London, 1927 The numbers have been brought up to date with the kind help of the author

from these discoveries in Great Britain and Ireland, and from the remarkable profusion of ant-mimics and ant-associates in the tropics, that in spite of all attacks, these insects possess in the highest degree the qualities which render them valuable as models

I now propose to direct your attention to certain experiments and observations which throw light on the brain and senses of vertebrate enemies of insects Although the experiments brought before this section at Manchester in 1887 were few and single, I believe, and I still believe, they were crucial, and proved beyond doubt that the mind and memory of even a reptilian enemy—and of course far more probably an avian enemy—are such as we should expect to find in the selective agents which have brought about the evolution of mimicry in insects I refer to the chameleon, which, *after rejecting a bee which it had captured* the moment after its introduction into the cage—after this single experience—would never touch another, although offered from time to time during many months, also to the lizard, which approached a hornet-like clearwing moth with the utmost circumspection, and in finally seizing it kept as far as possible away from the supposed sting, and then, evidently realizing from the texture that the insect was not a wasp or hornet, proceeded to eat it without further caution, and a few days later recognized another at sight and instantly devoured it

It is not to be hoped that these experiments will carry the same conviction to those who only hear of the results and did not see them, but in recent years other evidence throwing much light on the faculties and behavior of birds has been steadily accumulating[55]

The conclusions of the distinguished ornithologists, E C Stuart Baker and Rev F C R Jourdain, that the resemblance of cuckoos' eggs to those of the fosterers has been evolved through the selective destruction of the less like by the birds which would otherwise have been victimized, obviously bear closely on the development of a mimetic pattern in insects The similarity between the two selective processes, both leading to a superficial likeness which changes with the geographical changes of the models, was made the subject of the address to the Entomological Society in January, 1926, and led to the last words addressed to me, although indirectly, by William Bateson, the distinguished ex-president of this section and of the association, whose loss we all deplore Not many days before his death he was present at the meeting and told a mutual friend that he was much interested in the observations and that they were quite new to him

Evidence of a different kind, but probably very significant, is provided by the well-known African Honey Guide (*Indicator*) which directs man to a bee's nest and is repaid by a meal on the scattered larvæ. My friend, Dr Neave, has told me that this bird, when insufficient attention is paid to its directions, becomes so noisy that game is disturbed, and he found it necessary, on hunting expeditions, to detail a couple of natives to follow the Guide and keep it quiet How far the behavior of the bird is instinctive and how far intelligent is, I believe, unknown, but it is impossible to imagine a more fascinating subject for investigation

Of more importance, because common to many species and known to exist in all the great tropical areas, is the nesting association between birds and the most formidable of insects—wasps and hornets, also with ants and termites In the association with wasps naturalists have definitely stated that the birds begin to build close to the already constructed pendent comb of a wasp, while their nests are actually excavated in the termite-mounds and in the huge nests of tree-ants This most interesting and significant behavior has been summarized for tropical America by J G Myers, who has confirmed the older records by his own observations and has also been led to the startling conclusion that at least one wasp tends regularly to make its nest besides the colonies of a tree-ant (*Azteca*) Notes on these associations in Africa have been written by A Loveridge and V G L van Someren, in India by E C Stuart Baker, in Australia by W B Alexander[56]

The behavior briefly described in the last two paragraphs proves, I believe, that birds possess a brain and sense-organs such as would lead them, in seeking their food, to associate the qualities, favorable or unfavorable, with the appearance, and to remember and apply their experience, in fact precisely the powers required by a selective agent in building up a mimetic pattern

To the above evidence may be added two examples of bird behavior in our own country The cocoon of the common "Lackey Moth" is thick on the exposed surface but thin where it is spun on to a leaf. Birds have discovered this and peck a hole through the leaf and thin wall in order to abstract the chrysalis[57] Many naturalists have observed that birds, although they frequently peck their way into the center of "bullet-galls" (often but erroneously called "oak-apples"), never do so when the enclosed insect has emerged, being doubtless guided by the sight of the small round hole or by tapping with the bill.[58]

What other hypotheses have been suggested by those who reject evolution by natural selection as the explanation of mimicry and allied adaptations? Some naturalists believe that the resemblances in question are accidental and of no biological significance This opinion, although defended by such an eminent entomologist as Professor Handlirsch,[59] is not likely to be held by any one who has seriously considered examples such as those brought before you to-day, or has studied the geographical distribution of mimetic associations Chance resemblances are, of course, bound to occur among the immense number of butterfly patterns throughout the world, but these will be as frequently found between the species of different countries as between those of the same country Such truly chance likenesses in patterns have been examined by my friend, Dr F A Dixey,[60] and have been shown to be relatively few and only to exist at all when the patterns are relatively simple The distinguished mathematician, the late Professor Study, of Bonn, who was deeply interested in mimicry, has shown, in two of his last papers, the impossibility of an explanation based upon chance resemblance, and I believe that the same conclusion will be reached by any one who reads the chapter on mimicry in Dr R A Fisher's recent work.

---

[55] Nearly all these observations are recorded or quoted with full references in the Proceedings of the Entomological Society of London in recent years, and will be easily traced

[56] *Proc Ent. Soc Lond*, vol. iv., p. 80, (America) 1929; p. 88 (Africa); p. 89 (India), vol. v., p. 111 (Australia) 1930; vol. vi., p 84 (India) 1931.

[57] Observed by A. H. Hamm. *Ibid.*, p. xv., 1902.

[58] *Ibid.*, vol. iii., p. 50, 1928; vol. iv., p. 10, 1929.

The view has sometimes been held that mimetic resemblances are due to model and mimic independently passing through the same stage of evolution, either as a whole or in the mimetic features only, or, as Darwin once suggested, "that the process probably commenced long ago between forms not widely dissimilar in color[61] I remember, at the Leeds meeting in 1890, when Professor Patrick Geddes suggested the former interpretation, that the late Lord Rayleigh remarked, "How would you apply your explanation to the resemblance of insects to bark, or twigs, or leaves?"[62] It is strange that this fatal objection did not occur to Darwin, for Bates himself in the great paper had written · "I believe that the specific mimetic analogies exhibited in connection with the *Heliconidæ* are adaptations—phenomena of precisely the same nature as those in which insects and other beings are assimilated in superficial appearance to the vegetable or inorganic substance on which, or amongst which, they live The likeness of a beetle or a lizard to the bark of the tree on which it crawls can not be explained as an identical result produced by a common cause acting on the tree and the animal "[63]

Before concluding, a few lines must be devoted to recent work on sexual selection, first briefly introduced as a factor in evolution by Darwin in the Joint Essay. Nothing would have interested and pleased him more than discoveries which, following the splendid pioneer work of Fritz Muller, have been made in the epigamic structures and behavior of insects—the extensive observations on the scents of male butterflies, by Dixey and Longstaff, and on their scent-scales by Dixey; the structure and use in courtship of the scent-brushes of male Danaine butterflies, by Eltringham, Lamborn and Hale Carpenter, the extraordinary brushes protruded from the back of the head by the males of *Hydroptila* (Trichoptera), by M E Mosely and Eltringham, the courtship of Empid flies, including the spinning of a cocoon as a wedding gift by the male *Hilara,* by Hamm and Eltringham,[64] the fertilization of orchids (*Ophrys*) by male bees (*Andrena*) which, emerging before the other sex, are attracted by female-like appearances, and probably scent, of the flowers, by Pouyanne, confirmed by M J Godfrey and by Mrs Coleman, who has observed the fertilization of an Australian orchid (*Cryptostylis*) by a male Ichneumonid (*Lissopimpla*), similarly attracted to the flower

On two occasions I have been present when the late Lord Balfour expressed his opinion on the theories of evolution we have been considering to-day, and I am sure that naturalists will be glad to hear the conclusions reached by his keen and penetrating intellect on subjects in which, although without the time, or indeed the inclination to probe far into details, he took the keenest interest. We know that, even before he went to Cambridge in 1866, he had read and admired the "Origin," and we have been told by his nephew, Lord Rayleigh, of his "extraordinary faculty for getting hold of the essentials of a subject without apparently feeling the need for systematic study[65]

Over forty years ago, when the results of Weismann's researches were extinguishing the Lamarckian element which had been added to the Darwin-Wallace theory, I heard Lord Balfour say that to him, as a student of philosophy, the new teachings on the scope of heredity were more interesting than the old. Again, in 1927, a few months before his eightieth birthday and before he began to dictate the charming but too brief "Chapters of an Autobiography," he said that, looking back, he was impressed by the fact that nothing suggested in later years had replaced or modified the Darwinian theory of evolution

---

[59] *Handbuch der Entomologie.*

[60] *Proc Ent Soc. Lond.*, p lx., 1913. As regards chance likeness in form, Bates wrote in his great paper (p. 514 n): "Some orders of insects contain an almost infinite variety of forms, and it will not be wonderful, therefore, if species here and there be found to resemble each other, although inhabiting opposite parts of the earth, and belonging to widely different families Such analogies are accidental, and can have nothing at all to do with the evidently intentional system of resemblances, carried on from place to place, which I have discussed "

[61] *Essays on Evolution*, p. 238 n.

[62] *Proc. Ent. Soc. London.*, p. xcv., 1925–26.

[63] *Ibid* , p 508

[64] *Ent. Monthly Mag* , p. 177, 1913, *Proc Roy Soc.*, B., vol. cii., p 327, 1928. All the other observations are recorded, with full references to earlier publications, in the *Trans.* or *Proc. Ent. Soc. Lond.*

[65] *Proc. Roy. Soc.* B., vol. 107, p viii , 1930.

And now in conclusion, speaking at the close of the second half-century of our society's life, and speaking as one who owes more than he can express to the kindness and help received at these meetings, I can not do better than remind you of prophetic words spoken at Oxford in 1832 Professor Adam Sedgwick, responding after his nomination as president at Cambridge in the following year, said that the work of the association at the meeting which had just been held could not but tend "to engender mutual friendship, mutual forbearance, mutual kindness and confidence", and, for the future, "he looked forward with full assurance to the happy results of this union between men of similar sentiments and similar pursuits, who possess one common object—the improvement of mankind by the promotion of truth"

SCIENTIFIC EVENTS

THE INTERNATIONAL GEOLOGICAL EXPEDITION

AN international expedition under the sponsorship of Princeton University will make a concentrated study next winter of the geological structure of the West Indies, it was recently announced by Professor Richard M Field, of Princeton University, director of the expedition

The U S Navy is cooperating in the project and will place a submarine at the disposal of the expedition The submarine will assist the investigators in obtaining as nearly stable conditions as possible for under-water gravity tests The U S Coast and Geodetic Survey, the Royal Society of Great Britain and the National Research Council are other national organizations cooperating with Princeton University in the expedition

The data which the expedition will obtain during its ten weeks' stay in the West Indies are expected not only to aid in determining the relative stability of the islands and the manner in which they have been formed, but also to throw further light on the origin of the major inequalities on the earth's surface, particularly the origin of folding and faulted mountain ranges

About 5,000 miles of submarine profiles will be measured and 30 or 40 gravity-at-sea stations will be established The submarine will be used in this phase of the expedition's work The new "three-pendulum" apparatus, which is the latest device for determining the difference in gravity at different points on the surface of the earth, will be used in the work of "weighing" the islands and the "deeps" The data to be obtained may also be of assistance in determining the location of earthquakes

Land gravity stations will be established by the U S Coast and Geodetic Survey with the help of Mr Hugh Matheson, of Miami, Florida The plans also call for the drilling of bore-holes to determine the structure of the islands

Soundings and charts which the expedition will make will be of assistance to ships navigating in the West Indian waters in the future The expedition will begin work early in February

The personnel of the advisory staff and of the expedition is as follows

Navigation Rear-Admiral W R Gherardi, chief hydrographer, U S Navy, Hugh Matheson, Miami, Florida

Geophysics Rear Admiral Gherardi, Dr William Bowie, chief, U S Geodetic Survey, Dr F Vening Meinesz, Geodetic Survey of the Netherlands, Dr F E Wright, U S Geophysical Laboratory, George W Littlehales, hydrographic department, U S Navy

Tectonics or mountain building Dr Arthur Keith, U S Geological Survey, Professor E B Bailey, chairman of the department of geology of the University of Glasgow, Professor Owen Thomas Jones, chairman of the department of geology, Trinity College, Cambridge, England, Professor R T Chamberlin, chairman of the department of geology of the University of Chicago, Professor Walter H Bucher, professor of geology at the University of Cincinnati, Professor W T Thom, associate professor of geology at Princeton University, senior geologist, U S Geological Survey, and chairman of the petroleum committee of the National Research Council

Oceanology Professor Edwin Grant Conklin, chairman of the department of biology of Princeton University, Dr Charles Fish, director of the Buffalo Museum of Science, Professor Ulric Dahlgren, professor of biology at Princeton University

Sedimentation Professor Alexander Hamilton Phillips, chairman of the department of geology of Princeton University, Professor Richard M Field, associate professor of geology at Princeton University and director of the International Summer School of Geology, Ernest Dixon, of the Geological Survey of Great Britain, Maurice Black, fellow of Trinity College, Cambridge, England, Dr Edward M Kindle, chief of the division of paleontology, Geological Survey of Canada, Professor John Sandidge, of the department of geology of Princeton University

Marine Bacteriology Dr Selman A Waksman, microbiologist, State of New Jersey Agricultural Experimental Station, and associate professor of microbiology at Rutgers University.

INDUSTRIAL RESEARCH IN THE NATION'S INDUSTRIES

A tour of research laboratories this fall by one hundred business men and bankers, the purpose of which is to show members of the party what the nation's industries, small and large, are doing in the field of industrial research, has been announced by Professor Dugald C Jackson, head of the electrical engineering department of Massachusetts Institute of Technology, and chairman of the division of engineering and industrial research of the National Research Council, the sponsors of the tour

The program of the tour, which is scheduled to take place from October 5 to 14, inclusive, provides for visits to fourteen laboratories, in which research activities by a large variety of industries will be disclosed Members of the party will have an opportunity to see the latest developments in photography, light, color, electronics, x-rays, industrial chemistry in many phases, rubber research, dirigible construction and other aspects of aviation, motors, electrical apparatus, leather-tanning, research in metals and fuels, etc

The tour started from New York City, where the party took one of the Eastern Steamship Line boats for Boston The remainder of the trip was by special train On October 6, a visit was made in the morning to the Massachusetts Institute of Technology, in the afternoon, visits to the following organizations were optional Arthur D Little, Inc , Dewey and Almy Chemical Company, and the New England Confectionery Company, all of Cambridge, the United Drug Company and the Thompson and Lichtner Company, Inc, both of Boston Tour activities in and around Boston were conducted with the New England Council as hosts

During the remainder of the trip the following are among the organizations to be visited On October 7, the Eastman Kodak Company, Rochester, N Y , on October 8, the Goodyear Tire and Rubber Company, Akron, Ohio, and Nela Park, Cleveland, on October 9, the Ford Motor Company, Dearborn, Michigan, on October 10, Tanners Council of America and General Foods Corporation, both at the University of Cincinnati, on October 12, the Battelle Memorial Institute, Columbus, Ohio, on October 13, the Westinghouse Electric and Manufacturing Company, Pittsburgh On October 14, the party will return to New York City.

Details of the tour have been worked out by Mr Maurice Holland, director of the division of engineering and industrial research of the National Research Council, who had charge of the arrangements of a similar tour under the same auspices last October, when the following nine laboratories were visited. The Bell Telephone Laboratories, New York City; the General Electric Company, Schenectady; the General Motors Corporation, Detroit; the Material Division, Air Corps, U S Army, Wright Field near Dayton, the American Rolling Mill Company, Middletown, Ohio, the Aluminum Company of America and Mellon Institute of Industrial Research, both of Pittsburgh, the U S Bureau of Standards and the National Canners Association, both of Washington

THE NEW ENGINEERING BUILDING AT THE UNIVERSITY OF WISCONSIN

The new mechanical engineering building erected at the University of Wisconsin during the past year at an approximate cost of $577,000 was used for the first time in September

Several hundred tons of ponderous steam and gas engine machinery, some of which has been in use in the training of a generation of University of Wisconsin engineering students, was moved into the new building during the summer months from the old engineering building on the upper campus, under the direction of Professor J M Dorrans, assistant professor of mechanical practice and superintendent of the machine shops

Located at the north end of Camp Randall, the new engineering building is constructed of Madison sandstone, with a frontage of 238 feet and with two wings, each 210 feet long Built in U-shape, it is three stories high, and contains a mechanical laboratory two stories in height, thus giving necessary space for tall equipment Besides the general machine laboratories, containing 67 huge machines, and the steam and gas engine laboratory, the building contains various shops, departments, offices, classrooms and drafting rooms

The new building, which was dedicated during the latter part of June, has been designated as the third milestone in the history of the Wisconsin College of Engineering by Dean F E Turneaure, who joined the engineering staff at the university thirty-nine years ago The first two milestones, according to Dean Turneaure, were the expansion of the engineering teaching staff in the fall of 1891 and the completion of the present College of Engineering Building in 1900, the new building marks the first major addition to the space assigned to the engineering college in more than thirty years

In the new building is a large picture of Colonel Charles A Lindbergh, hanging on the wall of the front hall of the new building, and directly opposite it, suspended by cable from the ceiling, is a large navy biplane, which was given to the college by the navy some time ago The picture, portraying Colonel Lindbergh in flying togs, is approximately eight feet wide and ten feet long, and was painted for the building by painters at the service building of the university a year or so ago. It recalls the fact that Colonel Lindbergh was enrolled in the college of engineering at the University of Wisconsin some years ago.

THE CANAL ZONE EXPERIMENT GARDENS

WITH the slow but constant increase in the development of agriculture in the Republic of Panama, there should be a considerable amount of interest in the "Annual Report of the Canal Zone Experiment Gardens," according to the *Panama Star and Herald*, an official publication of the Panama Canal

The experiment gardens were established several years ago, and prior to that time practically nothing had been done in the matter of the scientific development of agriculture on the Isthmus The gardens have been operated on a most modest scale and emphasis has been laid on the development of trees and vines, fruits and flowers, as well as the so-called economic plants As to the relatively unimportant matter of plants and flowers, the situation was well summed up by Dr Paul C Standley, who said, in speaking of flora of the Canal Zone "There is probably no region of Central America which exhibits so mediocre a selection of horticultural or ornamental plants as does this part of Panama Scarcely one garden plant of any special interest is seen about Panama City, all those planted being the most ordinary and wide-spread tropical ornamentals"

All that has been changed and the experiment gardens have provided hundreds of new varieties gathered from many remote parts of the world

As an example of the work being done, reference may be made to the introduction, propagation and dissemination of the varieties of sugar cane The report points out that the sugar industry in Panama is at present suffering much from the mosaic disease and other pests, and that there is a need of varieties of cane resistant to this disease and also of higher sugar-yielding capacity

To meet this need the gardens introduced many varieties of cane, including a number that have proved satisfactory in other countries During the last year sample lots for testing under plantation conditions have been distributed without charge to cane growers in the republic New varieties are constantly being received and developed The same work is being done with rice—great quantities of which are imported into Panama

While emphasis is placed on the development of those things which give most promise of producing economic results, the ornamental plants and trees are not being overlooked, and many new varieties, hitherto unknown to the Isthmus, are being constantly introduced and developed. Mention might also be made of the strides which have been made in the scientific development of the avocado, the mango, the pineapple, the banana and even the fig

Just recently Governor Roosevelt, of Porto Rico, pointed out the great advantages which would result from the establishment by the government of the United States of extensive agricultural experiment stations in the tropics Both the necessity and the advantages of such outlying stations can not be overestimated

The valuable work which has been started at the Canal Zone Experiment Gardens at Summit might well be conducted under the U S Department of Agriculture The cost of operating the gardens would not be great and in all probability the expenditure of a sum not greater than $75,000 a year would produce results of incalculable value to the agricultural interests of this part of the world and would be a service worth many times its cost in the good-will engendered

THE NATIONAL ARBORETUM

As an initial step in the development of the proposed national arboretum, the marshland along the Anacostia River in the outskirts of Washington, two and a half miles from Capitol Hill, is being drained by army engineers With the appropriation of $300,000, which the Congress set aside for the project in 1927, a tract of 268 acres of land has been purchased The physiography of the area ranges from the water gardens of Kenilworth to the wooded heights of the Hamilton and Hickory Hill tracts, which will be included in the arboretum The two bodies of land afford the diversity of soil and physiography needed for many types of plants

The U S Department of Agriculture has hitherto been unprovided with a field laboratory of the proper size for experiments with the plant life of the country and horticulturists have supported its efforts to obtain one A garden will be established to preserve specimens of plant life which come to the Agricultural Department from all parts of the world.

The arboretum will have laboratory facilities as well as museum characteristics Cultivated and wild plants growing side by side, in the same type of soil and in the same climate, will be studied to aid the breeding of more valuable species.

Horticulturists will have an opportunity to carry on research in developing desirable types of plants with superior qualities from available stock in different localities, and through experimentation it may be possible to eliminate many diseases which now threaten our forests in many sections of the country, such as maple wilt, elm-leaf disease, chestnut blight and many others.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM H WELCH, professor of the history of medicine at the Johns Hopkins University, has been made an honorary member of the International Neurological Congress. Other honorary members elected were Professor M Allen Starr, of Columbia University, Professor Ivan P Pavlov, of the University of Leningrad, Professor J Wagner-Jauregg, of the University of Vienna, Professor Pierre Marie and Dr J Babinski, of the University of Paris, Professor Gabriel Anton, of the University of Halle, and Professor Eugenio Tanzi, of the University of Florence

DR. WITMER STONE, vice-president of the Academy of Natural Sciences of Philadelphia and curator of its department of vertebrate zoology, has been awarded the Otto Hermann medal of the Hungarian Ornithological Society—the highest honor conferred by that organization—in recognition of his "outstanding work in the science of ornithology"

DR. STEPHEN H LANGDON, professor of Assyriology at Oxford University, and Dr Ludwig Diels, director of the Botanical Garden and Museum of Berlin-Dahlem, have been elected corresponding members of the Field Museum of Natural History by the board of trustees, in recognition of their eminent services to the museum

DR. LAUGE KOCH, Danish explorer, has received the Charles P Daly Medal for 1930 from the American Geographical Society.

PROFESSOR CARL NEUBERG, director of the Kaiser Wilhelm Institute for Biochemistry, has been awarded the Pasteur and Leblanc Medals, and the Pasteur Commemoration plaquette

DR. WILLIAM A EVANS, radiological specialist of Detroit, has been elected president-elect of the American Roentgen Ray Society, at the thirty-second annual meeting, held at the Chalfonte-Haddon Hall Hotel on September 24 Other officers elected were Dr. B R Kirklin, of Rochester, Minn, and Dr Ross Golden, of New York, vice-presidents; Dr E P Pendergrass, of Philadelphia, secretary, and Dr. Edward L. Jenkinson, of Chicago, treasurer.

AT the annual meeting of the Geographical Society of Philadelphia Mr. Henry G. Bryant was elected president, a position he has repeatedly filled since 1894. Subsequently the board of directors appointed Dr. Lester E Klimm, assistant professor of geography, University of Pennsylvania, as part-time executive secretary and acting editor of the bulletin of the society.

DR. CHARLES FRANKLIN BROOKS, professor of meteorology and climatology at Clark University, will become, in February, A Lawrence Rotch professor of meteorology at Harvard in succession to Professor Alexander G McAdie, who has become Rotch professor and director, emeritus Until February Dr Brooks will spend half of his time in Cambridge and half in Worcester

DR. E D BALL has resigned as dean of the college of agriculture and director of the agricultural experiment station of the University of Arizona, to accept the position of professor of zoology and zoologist of the experiment station, in order to be able to devote more time to research

THOSE who are new on the faculty at the Case School of Applied Science include Mr Ervin W McCullough, consulting engineer with the Republic Creosoting Company, who has been made professor of mining engineering, and Dr P E Hemke, who has been made associate professor of mechanics

NEW appointments at the University of Minnesota include the following as assistant professors Mr Ira D Beals, in architecture, Mr Russell E Gibbs, in steam engineering, Mr James J Ryan, in machine design, and Mr Michael A Sadowsky, in mathematics and mechanics Professor George H Montillon was promoted from associate professor to professor of chemical engineering. Mr Chester A. Hughes and Mr Joseph A Wise were promoted to associate professors of civil engineering

THE following appointments to the faculty of the school of engineering of the Pennsylvania State College are announced Dr L F Pilcher, formerly vice dean of the faculty in the college of arts of the University of Pennsylvania, who has returned after an absence of one year, will take charge of architectural design, Dr. Clarence Hammond Kent, formerly head of the department of mechanical engineering at the University of Arkansas, has been appointed associate professor of mechanical engineering, Mr P X Rice becomes assistant professor of electrical engineering, Mr. P P. Henshall returns as assistant professor of industrial engineering Instructors appointed are Mr Clifford B Holt, in electrical engineering, Mr. J O. P. Hummel, in industrial engineering; Mr. R. C. Gersen, in engineering drawing, Mr William H. Peters, and Mr. J S Doolittle, in mechanical engineering

DR. CHARLES S ROBINSON, in charge of the chemical division of the Michigan Experimental Station, has been elected professor of biochemistry in the Vanderbilt University School of Medicine, replacing Dr. Glenn E. Cullen, who has resigned to become director of laboratories at the Institute of Pediatric Research of the University of Cincinnati Medical School

DR GEORGE A DICK has been appointed dean of the school of veterinary medicine at the University of Pennsylvania He succeeds the late Dr Harold E. Bemis, who died in April Promotions announced by President Thomas S Gates are as follows Dr James A Shohat has been made assistant professor of mathematics in the college, in the school of medicine Dr Stuart Mudd has been appointed associate professor of bacteriology Assistant professors are Dr Donald M Pillsbury, in dermatology, Dr Roy G Williams, in anatomy, Dr Joseph Stokes, Jr, who also will hold the William H Bennett memorial chair of pediatrics Professors in the graduate school of medicine are Dr Ralph Pemberton, in medicine, and Dr William D Stroud, in cardiology Assistant professors are Dr Edward W Beach, in anesthesia, and Dr Truman G Schnabel, in medicine In the Towne Scientific School, Dr Ernest C Wagner has been appointed professor, and in the Moore School of Electrical Engineering, Mr Charles DeV Fawcett has been made professor of engineering In the school of medicine Dr Edward A Strecker, formerly a member of the faculty of Jefferson Medical College, has been appointed professor of psychiatry The graduate school of medicine has added to its faculty Dr Clarence R O'Crowley, of Newark Dr Arthur B Gabel, of Seattle, has been named assistant professor of operative dentistry in the school of dentistry

DR HARRY BECKETT LANG, of the staff of Willard State Hospital, Willard, N Y, has been appointed clinical director at Marcy State Hospital, Marcy, N Y

THE U S Bureau of Fisheries announces a change in the directorship of the U S Fisheries Biological Station at Beaufort, N C Dr S F Hildebrand, who has occupied that position for the past six years, has been transferred to Washington as senior ichthyologist of the bureau, where he will continue his studies of fishes with the superior facilities of the library and museum collections available in that city The position of superintendent and director of the Beaufort station has been filled by the appointment of Dr Herbert F Prytherch Laboratory facilities at the station will be made available for independent investigators in hydrobiology throughout the year, and the station will serve as headquarters for Dr Prytherch's theoretical and practical studies on the biology of the oyster and the development of oyster culture in the South Atlantic states As a result of examinations held by the U S Civil Service Commission early in the summer, the Bureau of Fisheries announces the appointment of Mr William C Herrington as aquatic biologist to take charge of a major investigation of the haddock fishery of the North Atlantic Dr Frederic F Fish has been appointed associate aquatic biologist for investigations in fish pathology Dr Paul R Needham, formerly of the University of Rochester, has been appointed as associate aquatic biologist for investigations in hydrobiology and aquiculture Dr A S Hazzard has been appointed to undertake extensive duties as associate aquatic biologist in charge of fish cultural and stocking policies in the national parks of the Rocky Mountain region with headquarters at Salt Lake City, Utah

DR ROBERT CUNNINGHAM MILLER, of the University of Washington, will return to Seattle this month after two years' leave spent as visiting professor of zoology at Lingnan University, Canton, China During the summer he has been collecting marine wood-boring organisms along the coasts of South and East Africa, also conducting certain investigations for the University of Washington Oceanographic Laboratories while at sea

PROFESSOR HOMER C WILL returns to Juniata College as head of the biology department after a two year's leave of absence for graduate study in the University of Michigan and the University of Pittsburgh

PROFESSOR MARSHALL P CRAM, professor of chemistry at Bowdoin College, has been granted a sabbatical leave of absence for the coming year

ON the recommendation of the secretary of state for Scotland, Dr John Glaister, Jr, professor of forensic medicine in the University of Egypt at Cairo, has been appointed to the chair of forensic medicine in the University of Glasgow He is the son of the present occupant of the chair

DR ARTHUR H COMPTON, professor of physics at the University of Chicago, who recently returned to the university from an expedition in the Rocky Mountains, where he conducted a series of experiments on the cosmic rays, has left for Europe with Mrs Compton He will attend the International Physics Conference to be held at Rome from October 11 to 19, under the auspices of the Volta Foundation At the conclusion of the conference he will go to Zurich to conduct further experiments with cosmic rays, to determine the difference in intensity in the Alps as compared with the Rocky Mountains

DR W W SWINGLE, of Princeton University, will deliver the first Harvey Society Lecture at the New York Academy of Medicine, on Thursday, October 15. His subject will be "The Hormone of the Suprarenal Cortex"

The George Fisher Baker non-resident lecturer in chemistry at Cornell University for the present university term is Professor Cecil Henry Desch, who has held the professorship of metallurgy in the University of Sheffield up to last June, but who, on his return to England next February, will enter upon the position of superintendent of the metallurgical department at the National Physical Laboratory in Teddington. He is the twelfth holder of the non-resident lectureship founded by George Fisher Baker in 1925, which in accordance with the terms of the foundation is filled in succession by men eminent in chemistry or in some related branch of science.

Dr. A. C. Baker, senior entomologist and in charge of tropical and subtropical plant insect investigations, of the U. S. Bureau of Entomology, left on September 25 for Mexico City, where he will study the Mexican fruit fly and related species. Dr. C. L. Marlatt, chief of the bureau, in announcing Dr. Baker's transfer to Mexico City, explained that citrus plantings in the Lower Rio Grande Valley have expanded rapidly and a few adult flies have appeared in this region.

The *British Medical Journal* reports that an international Federation of Societies of Tropical Medicine and Hygiene has been constituted, under the presidency of Professor C. Achard, by the association of leading authorities on tropical medicine from twenty countries. At the invitation of the editorial committee of the *Revue pratique des Maladies des Pays Chauds,* various societies will exchange views on different subjects in order to bring into being a legal constitution for the international federation.

Nature reports that a meeting was recently held of the subcommittee on symbols, units and nomenclature used in physics, appointed by the International Union of Physics. Sir Richard Glazebrook was appointed chairman of the committee. Professor Kennelly, as chairman of the section of the advisory committee of the international electro-technical commission dealing with electrical and magnetic magnitudes and units, wrote, directing attention to the meeting of his committee in London on September 18, and inviting members of the committee of the International Union of Physics to attend. This invitation was accepted, and the meeting of the subcommittee on symbols, units and nomenclature shortly afterwards continued the discussion commenced at Brussels.

At the close of the second International Hospital Congress, which met in Vienna from June 8 to 14, the representatives of the 41 countries participating in the congress voted unanimously to organize an International Hospital Association. The purpose of the association is to bring about an international exchange of opinion and international cooperation in all problems and in all fields of hospital work and in all relationships, economic, sociological and hygienic. The association is composed of two classes of members—ordinary members, consisting of national hospital associations, and associate members.

The U. S. Civil Service Commission announces that applications for the positions of associate and assistant metallurgists (optional subjects—ferrous metallurgy, non-ferrous metallurgy, physical metallurgy and ore dressing) must be on file with the commission at Washington, D. C., not later than December 30, 1931, except that the commission reserves the right to issue subsequent notice closing the receipt of applications before that date. The examinations are to fill vacancies in the departmental and field services. The entrance salaries for associate metallurgist range from $3,200 to $3,800 a year, and for assistant metallurgist from $2,600 to $3,200 a year. Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience and fitness, and on a thesis, reports or published writings. Applicants must have been graduated with a bachelor's degree from an institution of recognized standing, with major work in chemistry, physics or metallurgy. Certain specified experience or postgraduate education is also required. Full information may be obtained from the secretary of the U. S. Civil Service Board of Examiners at the post office or customhouse in any city or from the U. S. Civil Service Commission, Washington, D. C.

Plans have been filed for erecting a six-story addition to a new building occupied by the New York Academy of Medicine and opened in 1926, at the southeast corner of Fifth Avenue and 103rd Street, New York. The cost will be $450,000. Construction will not begin until the academy has raised an additional $95,000. The annex will be used for offices, committee rooms, for the exhibition and storage of books on historical medicine and library services. The old building of the academy, constructed in 1888, at 15 to 21 West 43rd Street, was sold in 1925, and is now being demolished.

A laboratory of anthropology, established to study the origin and development of the Americas, was formally opened in Santa Fe, New Mexico, on September 1. From this laboratory, which has been sponsored by John D. Rockefeller, Jr., expeditions in North, South and Central America will be directed. Regardless of their organization affiliation, scientific men may work individually or in collaboration with each other in anthropological research. The first unit is a building of pueblo architecture recently completed at a cost of $144,000. Dr. A. V. Kidder is chairman of the board of directors.

The Shippee-Johnson Peruvian Expedition, which sailed from New York on December 6, 1930, to carry out, with the endorsement of the American Geographical Society, a program of aerial mapping and other photographic work from the air in various parts of Peru, returned on September 7 In spite of numerous delays occasioned by the unstable conditions in Peru the expedition was able to accomplish even more than had been planned in its tentative program In addition to the mapping, from elevations of over 25,000 feet, of the deep valley of the Colca River some seventy miles north of Arequipa—the primary object of the expedition—a land party spent two weeks in the valley studying its people, the history of the little-known agricultural communities of the valley floor, their methods of agriculture, etc Archeologists as well as geographers will be interested to know that the expedition mapped the whole of the Chimú Valley and the ruins of Pachacamac and discovered and photographed, a short distance north of Chimbote, the remains of what appears to be a great defensive wall believed by Peruvian archeologists to be a part of the Chimú fortifications against the Inca invaders Besides the aerial mapping, hundreds of aerial photographs were taken and a large amount of motion picture film exposed throughout the coastal region of Peru and the western border of the Andes Several flights from Lima over the western range of the Andes to Huancayo resulted in a series of remarkable photographs of much geological and physiographic interest A report on the work of the expedition will appear in a forthcoming number of the *Geographical Review*

The *Pelican*, a ninety-foot motor vessel of the U. S Fisheries Service, loaned to the International Passamaquoddy Fisheries Commission by the United States Government, has just arrived in St Andrews Oceanographic equipment will be installed there and it is expected that within a few days active field work will begin A second vessel, the *Edward E Prince*, loaned to the commission by the Biological Board of Canada, has already been outfitted The *Pelican* was constructed during the past year at Newport News, Virginia, for the U S Fisheries Service at Boothbay Harbor, Maine The captain, George Greenleaf, has had considerable experience in oceanographic work, having formerly been associated with Dr. Fish in investigations for several years in the Gulf of Maine and for two years in Lake Erie, where a cooperative survey was carried on in 1929 and 1930 For the remainder of the summer season the two vessels will base at the Atlantic Biological Station, where headquarters for the commission have been established.

A loan exhibition of modern British optical instruments took place in the Science Museum, South Kensington, England, at the time of the British Association centenary meeting, and apparatus was loaned by a number of the leading manufacturers in Great Britain The display will be on view up to the end of October in the optical instrument gallery, and popular demonstrations will take place at intervals. About 100 exhibits have been provisionally selected, including binoculars, rangefinders, photographic and microscopic objectives, projection-microscopes and surveying instruments. Aerial cameras, microphotometers, spectrographs and a cinema projector are among the developments of optical technique to be illustrated, and a strain-viewer will demonstrate the differences and flaws to be observed in various everyday objects of glass

Preliminary plans for a new entomology building to be built at a cost of $150,000 for the University of California Experiment Station at Riverside were virtually brought to completion, following a recent conference of the director, Dr L D. Batchelor, members of the staff and R A. Weaver, of the department of buildings and grounds at Berkeley. The new building will be L shaped in floor plan, 100 feet on the longest side and 70 on the other The major part of the structure will be two stories in height with a basement and attic There will probably be a greenhouse in the attic and rooms for testing large power spray rigs in the basement Other facilities included in the plans are rooms for fumigation experiments, spraying investigations, taxonomical and physiological studies, etc Several of the rooms will be equipped for carrying on experiments requiring controlled environment with constant temperature and humidity The site selected for the new building is a short distance northeast of the main building of the experiment station, close to the recently completed insectary, the facilities of which it will supplement.

DISCUSSION

A NEW MATHEMATICAL REVIEW

For the first time in the history of mathematics there was inaugurated in April of the current year a monthly periodical exclusively devoted to the prompt review of mathematical publications or to the preliminary announcements of results which are expected to be published later *in extenso* in the technical journals. It appears under the heading *Zentralblatt für Mathematik und ihre Grenzgebiete*, and the reviews include, besides pure mathematics, such subjects bordering thereon as theoretical physics, astrophysics and geophysics The editor-in-chief is O Neugebauer, of Göttingen, who is well known as a mathematical historian, and the publisher is Julius Springer, Berlin

Judging from the first five numbers, which cover 384 pages, the reviews are unusually reliable and the publication promises to be very useful to those who try to keep in touch with the latest developments in the fields concerned While it covers to a large extent the same field as has been covered acceptably for more than half a century by the "Jahrbuch über die Fortschritte der Mathematik" its more prompt and more frequent appearance tend to make it a welcome supplement thereto It seems to have exercised already a wholesome influence on this annual since the parts of the latter have recently appeared much more promptly than theretofore.

In addition to these two reviews, which are published in Germany, the mathematical public has had the advantage since 1893 of another very useful periodical devoted to reports on recent publications in its field and appearing in various countries This periodical is published under the auspices of the Mathematical Society of Amsterdam and appears under the title *Revue Semestrielle des Publications Mathématiques* A very useful supplement to this periodical appears in the form of supplementary volumes each covering a period of five years The main novel feature of the new periodical noted above is therefore the rendering of prompter service to the mathematical student of to-day.

G A MILLER

UNIVERSITY OF ILLINOIS

ON THE IMPROVEMENT OF THE DICTIONARY

DICTIONARIES and all other word-tabulations are valuable in proportion to their comprehensiveness and to their ease of use. Assume that we have a comprehensive table How much it is used will depend mainly on how much trouble its use involves, or how fatiguing are the operations of the human eye and hand When I contemplate the fact that a certain German-English dictionary has no less than 15 two-column pages of words beginning with "sch" I am tempted to forego the pleasure of adding to my knowledge the English equivalent of some word in this group.

In looking up such a word as "schmieden" the attention is first focused upon the initial letter and the pages are turned to "s." Time and effort can here be saved if the edges of the pages are so cut that the whole alphabet is seen at a glance with the letters running vertically downward from A to Z along the right-hand edge. The thumb may be placed on "s" and the book opened at nearly the right page Turning a few pages brings one to "sch" Here the real trouble begins. The mental attention is no longer focused upon "sch" but upon "mieden" The eye strives to find these letters However instead of making them prominent and as easy to find as the first letter of a word the printer has artfully concealed them behind "sch" The eye must search through 15 pages looking always for the fourth letter of the word, then for the fifth letter, etc There are no heavy face type, no italics, no capitals to aid in this search It is veritably a game of hide and seek, and after a dozen such attempts the mind is fatigued, some of the words are not found, and the dictionary is thrown down in irritation How much more convenient it would be with the elimination of all syllables or even all letters common to the series, after they have once been given. Such is the present day practice in tables of numbers Common figures are eliminated. The following tables show. 1, an old number table; 2, the typical present day arrangement; 3, the usual way of listing words; 4, the proposed system.

Table 1		Table 2		Table 3	Table 4
N	log N	N	log N	Usual system	Proposed system
150	17609	151	17609		
151	17898	2	898	schmelz	schMELZ
152	18184	3	18184	schmelzarbeit	ARBEIT
153	18469	4	469	schmelzbar	BAR
154	18752	4	752	schmelzhafen	HAFEN
155	19033	5	19033	schmelzwerk	WERK
156	19312	6	312	schmer	schMER
157	19590	7	590	schmergel	GEL
158	19866	8	866	schmerhaft	HAFT
159	20140	9	20140	schmerz	Z
160	20411	160	411	schmetterling	schMETTERLING
				schmettern	N
				schmetterschlag	SCHLAG
				schmidt	schMIDT
				schmied	schMIED
				schmiedbar	BAR
				schmiedbarkeit	BARKEIT
				schmiede	E
				schmiedearbeit	schmiedeARBEIT
				schmiedeeisen	EISEN
				schmiedeeisern	EISERN
				schmiedefeuer	FEUER
				schmiedeherd	HERD
				schmiedeisen	schmiedEISEN
				schmiedeisern	EISERN
				schmieden	EN
				schmiegen	schMIEGEN
				schmiegsam	SAM

I think, so far as is possible, that it is better to introduce whole new syllables rather than each new letter by capitals, *e g*, by schMIDT, schMIED, rather than schmIDT, schmiED, because the latter seems to distort the apparent pronunciation of the words Speed and facility in the use of number tables have been enormously enhanced by the modern arrangement, and I believe the same advantages will be gained by modernizing the old "Worterbuch." In regard to cost, I have the opinion of an experienced professional book-printer that the cost of typesetting will be less for the proposed system. Many printers maintain the practice of capitalizing the initial letter of all German nouns This could not be done in a table such as Table 4, but the nouns and their genders may be indicated by the italicized letters *m, f,* or *n* immediately following

"Sch" is not the only offending prefix The same book has 7 pages of words beginning in "ab," 4 pages "auf," 7 pages "be," 2 pages "durch," 4 pages "ein," 1 page "gesch," 3 pages "uber," 6 pages "un," 10 pages "ver," 3 pages "vor," etc This is not a defect peculiar to this book, nor to the German language which Mark Twain reviled so heartily in his story of the "Hottentotenmutterattentaterbeutelrattenlattengitterwetterkotter" On the other hand all dictionaries including those of English words suffer the same shortcoming So far as is possible let common words and syllables be omitted, and the distinguishing letters be printed in bold face or capitals, and reading such books will become a pleasure Thus the chief obstacle to foreign language reading will disappear, wasted mental effort and eye-strain will be reduced, and the publishers will gratify their ambition to make two dictionaries flourish where one languished before

NELSON W TAYLOR

UNIVERSITY OF MINNESOTA

TERRACES IN THE CONNECTICUT VALLEY

THE terraces of the Connecticut Valley in the region of Springfield and Hartford, studied at various times by Dana, Emerson, Alden and Fairchild and more recently investigated by the writer,[1] continue to offer new material for discussion The writer considered these features to be prevailingly horizontal and chiefly of lacustrine origin, only minor individuals being overlain by fluviatile deposits with profiles inclined down-valley Recently the writer, assisted by R M Logie, ran a level line with plane-table and stadia rod on the terrace at approximately 60 feet, extending with a few gaps through a distance of 22 miles along the eastern side of the river between Glastonbury, Connecticut, and the Massachusetts state line This terrace was found to be essentially horizontal, with a maximum relief of 18 feet, the highest parts being arranged opposite the mouths of two tributary streams in such a way as to suggest local fans built above the general surface of the terrace

Prior to this time Messrs Hitchcock and Wood, of the American Geographical Society, at the suggestion of Professor Douglas Johnson,[2] ran a more extensive series of Wye-level lines on several conspicuous terraces on both sides of the river between Windsor, Connecticut, and the Massachusetts line, and on extensive terraces in the Quinnipiac Valley Profiles constructed from these level lines show the terrace tops to be broadly irregular with inclinations generally down-valley Some of the profiles have distinct breaks at the levels at which the writer has described terrace surfaces, in a number of others the down-valley slope continues unbroken through these levels These profiles appear to the writer to indicate fluviatile deposition under the control of several base-levels and the writer considers that the terraces they represent consist of fluviatile material overlying lake deposits, while admitting that the fluviatile material is more widespread than he had formerly believed

During a recent two-day field conference with the writer Professor Johnson pointed out, on some of the broad lower terraces east of the river, shallow curved channels lying generally against eroded faces of the next higher terraces These resemble the channels found on many flood-plains and appear to indicate that the surfaces of the terraces on which they occur have been fashioned by streams and that the faces, previously interpreted by the writer as constructional, are chiefly erosional, whatever their original character may have been The channels were not recognized as systematic features by the writer until Professor Johnson called attention to them

Sections exposed in sand and gravel pits in these broad lower terraces exhibit current-bedding Some sections show varved clays and silts A few exposures show sections of what the writer has described as foreset beds exposed through thicknesses of a few feet, with their bases concealed Consideration of sections such as these raises a question as to the difference to be expected between deposits made by shallow aggrading streams, and deposits made in narrow lakes strongly affected by currents Perhaps the only positive criterion for stream deposits in such a comparison is the presence of buried channels visible in exposed sections One such channel, a few feet in diameter, is exposed in section in the lowest terrace east of the Connecticut River, two miles north of East Windsor Hill, Connecticut But since deposits built up above the surface levels of lakes by streams that succeed them might be expected to include filled channels, the lower as well as the upper parts of the sections should be examined for these features

In this connection Professor Johnson has suggested that my published statement that deltaic foresets are the predominant type of stratification in the terrace of Connecticut is misleading Even the sections showing foresets 15 feet or more in thickness have current-bedded topsets The writer has included in the deltaic category, without any intent to mislead, foresets exposed for only a few feet vertically and overlain by current-bedded deposits, in some exposures reaching a considerable thickness, such as are illustrated in Pirsson and Schuchert's "Textbook of Geology," Part I, Fig 95 1929 Edition It is true, however, that current-bedding predominates in a majority of the exposures The writer has roughly estimated at 25 per cent the proportion of exposures showing undoubted deltaic structure, whereas Professor Johnson would make the figure much lower

---

[1] "The Glacial Geology of Connecticut," *Conn Geol Survey Bull* 47, 1930

[2] Acknowledgment is made for permission to quote the results of this levelling, made as part of a general study of coastal terraces by Professor Johnson under the joint auspices of the American Geographical Society, the Carnegie Institution and Columbia University

As far as the lake- or stream-origin of a considerable part of the material composing the terraces in the Connecticut and Quinnipiac valleys is concerned, the presence of varved clays and silts in quantity beneath the sands in the lower terraces seems clearly to indicate lacustrine deposition In at least two excellent exposures the clays grade upward through varved silts into sands, which in turn exhibit delicate current-bedding A detailed and specific study of the relation of clays to sands throughout the valley might bring to light important additional data.

The facts indicated by Professor Johnson involve significant reinterpretations in the conclusions reached earlier by the writer, but they do not appear to the writer to preclude the belief that the lower terraces like those at higher elevations were formed while remnants of the last ice sheet still lay in the valley The discrimination of topographic features whose relief is scarcely perceptible or imperceptible to the eye is admittedly a difficult matter and it is to be hoped that further study may establish more clearly the details of the late-glacial history of the Connecticut Valley

Richard Foster Flint
Yale University

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFICATION OF THE OSBORNE-MENDEL SALT MIXTURE

Nutrition workers who have used the Osborne-Mendel salt mixture[1] in the preparation of experimental diets for rats will agree that this is a bothersome mixture to prepare Not only must great care be exercised in the addition of the strong acids to the carbonate mixture, but a slow evaporation process is necessary The removal of the hard mass of dehydrated salts and subsequent grinding present further difficulties

The authors have developed a salt mixture which, in so far as the metallic elements and mineral acids are concerned, is *of the same composition as that of* Osborne and Mendel The mixture is prepared from readily available salts, and requires no evaporation or dehydration Its content of water of crystallization is slightly higher than that of the Osborne-Mendel mixture The latter, when prepared according to the original directions (in the proportions required for 10 kilograms of diet), yields about 435 gm of dried mixture, whereas the equivalent weight of F R L mixture here described is 480 5 gm Hence in experimental diets prescribing 4 0 per cent of the Osborne-Mendel salt mixture, 4 4 (or 4 5) per cent of the F R L salt mixture may be substituted

Protracted feeding experiments in which the two salt mixtures were fed to divided litters of albino rats, both consecutively and in parallel, showed no differences in growth response

The composition of the F R. L salt mixture is as follows ·

Ca Citrate 4 H_2O		309 67
$\text{Ca}(\text{H PO}_4)_2$ H_2O		113 25
K_2HPO_4		219 72
KCl		125 29
NaCl		77 41
$CaCO_3$		68 90
$MgCO_3$		33 43
$MgSO_4$ (anhydrous)		38 50
Fe Citrate 1½ H_2O	94 18	13 80
NaF	3 68	
$MnSO_4$	1 17	
$K_2Al(SO_4)_4$ 24 H_2O	0 67	
KI	0 30	
	100 00	
		1,000 00

The weighed quantities of salts are thoroughly mixed (a McClellan batch mixer is recommended), and then finely ground in a steel mill

Philip B Hawk
Bernard L Oser
Food Research Laboratories, Inc,
New York City

A STAIN FOR FIBRIN, GRAM POSITIVE BACTERIA AND BASAL BODIES IN TISSUES

This stain is a modification of the Weigert and Gram-Weigert methods for fibrin and gram positive bacteria, respectively

Tissues are fixed in Zenker's solution (with 5 per cent. acetic acid) or Zenker-formalin (90 cc Zenker's plus 10 cc of 10 per cent formalin), they are mounted in paraffin and sectioned at 5 μ. After a very light hematoxylin stain they are thoroughly washed in tap water, then dipped into a one half per cent aqueous eosin (Grubler's *wasserlich*) for a half a minute and washed quickly again (Washing is done in large volumes of water) They are then stained in Weigert's aniline methyl violet made up as follows

---

[1] Osborne and Mendel, *J Biol. Chem*, 15, 311, 1913, 37, 557, 1919.

Solution 1	
Absolute alcohol	33 cc
Aniline oil	9 cc
Methyl violet in excess	
Solution 2	
Sat aqueous solution of methyl violet	
(For methyl violet use Grubler's 6B only)	

One part of Solution 1 is used to nine parts of Solution 2 for the stain The two solutions will keep separately, but after mixing, the stain will only last about ten days It seems to be best about three to eight days after making

The tissues are stained in the methyl violet about two hours, washed well in tap water and put into Lugol's solution for ten or fifteen minutes, after which they are again washed Each slide is then blotted thoroughly with filter-paper and subsequently differentiated in a mixture of one part aniline oil to two parts xylol After washing in several changes of xylol they are mounted in balsam.

The fibrin and gram positive organisms as well as ciliary basal bodies are stained a deep purple, the dark blue nuclei are well differentiated. All outlines of cells can be seen distinctly due to the counterstain Blood corpuscles are generally of a pale blue color, though at times they remain pink

This method has been used particularly in the study of fibrin and of pneumococci (though other gram positive organisms have been stained as successfully) and has proved of special value in the determination of intracellular bacteria.

Helene Mynchenberg Wallace
Department of Medicine,
University of Chicago

SPECIAL ARTICLES

AN OVO-TESTIS IN THE YELLOW PERCH (PERCA FLAVESCENS)

Hermaphroditism occurs fairly regularly in some genera of Teleost fishes (Serranus and Chrysophorous) and teratological hermaphroditism has been observed and described in the Burbot, Carp, Cod, Eel, Top Minnow (Fundulus, Lebistes, Xiphophorus), Stickleback, Herring, Ling, Perch (Perca fluviatilis), Salmon, Saigus, Shad, Whiting, Wrass, Sheepshead, Croaker, Trout and Loach In the latter cases the testis and ovary are seldom both full sized and normal Occasionally both gonads are developed to a point which would make functional hermaphroditism possible but usually one gonad is fully formed and normal while the other is partially developed or fragmentary and recognizable only by histological examination. Secondary sex characters such as colors, gonapods, internal structures and behavior are in some instances profoundly affected In other instances no such modifications are present

Non-functional hermaphroditism has been observed in the European Perch (Perca fluviatilis) by Halbertsma, Hoek, Ivanzov, Skogman and Chevey, but no record appears in the literature of any similar condition in the American Perch (Perca flavescens).

In the case described here the specimen was discovered by an employee of the Johnson Fish Company, of Green Bay, Wisconsin, in early February and the entire gonad was preserved in alcohol

The ovarian portion of the gland is 52 mm long and appears to be normal in every respect. It is located in the normal position An abundance of large ovocytes were plainly visible before dissection and on histological examination the usual arrangement within the ovary of fully formed ovocytes and of undeveloped germ cells was demonstrated. The stroma and tunica were also normal The testicular mass is somewhat larger than that of a normal testis and is located anterior to the ovary and while it is immediately adjacent to the ovary, it is marked off sharply by texture and color The testis is abnormal in position, therefore, and superficially appears to be tumorous and misshapen Several large and many small lobes appear, none of which have the shape of the normal testis. Microscopic sections of the testis, however, show little that could be called abnormal. All lobes are filled with masses of spermatozoa Each lobe is subdivided by connective tissue septa into cysts just as in the normal testis. At the peripheral margins of the lobes there are flat, lens-shaped cysts of large spermatogonia or primordial germ cells, a relationship which also exists in mature normal testes in February The only unusual histological feature is the thickening of the walls between some of the lobules and between the testicular and ovarian portions of the gland.

Special attention was given to the region between the ovarian and testicular portions of the gland in order to discover any possible transitional zone. No transition occurs. On both testicular and ovarian sides of the connective tissue junction the line of demarkation is abrupt and there is no evidence of anything but normal tissue.

Since the ovary is normal in every respect it seems likely that the fish was a female and that the abnormally shaped testis arose after the ovary was fully formed Had the testis developed along with the ovary in the young fish, it might be expected that neither ovary nor testis would be entirely normal in position or shape.

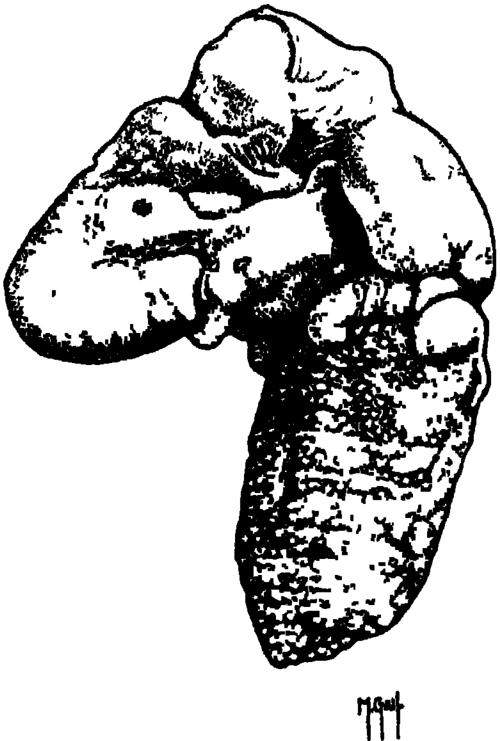


Fig. 1 Ovo-testis of Yellow Perch Irregular testis above, normal ovary below

What stimulation might cause the production of a testis in the presence of a normal ovary it is hardly profitable to guess It should be noted, however, that nothing in either portion of the gland is so antagonistic to the other as to prohibit the normal germ cell maturation in the other

Nothing could be made out of the accessory sexual apparatus but if sperm and eggs were provided with a means of escape from the body, the case might be classified as a rare instance of functional (even if teratological) hermaphroditism.

C. L. Turner

Northwestern University

THE CULTIVATION OF VACCINE AND OTHER VIRUSES IN THE CHORIO-ALLANTOIC MEMBRANE OF CHICK EMBRYOS

The successful infection of the chorio-allantoic membrane of chick embryos with fowl-pox virus led us to investigate the effect of the inoculation of other viruses upon this apparently highly susceptible tissue Thus far it has been found that the viruses of vaccinia and herpes simplex infect the membrane notwithstanding the fact that vaccine is only slightly pathogenic for adult fowls, and that repeated attempts to infect adult and young chickens with the virus of herpes simplex by a variety of routes have failed. The susceptibility of the chick's chorio-allantoic membrane to infection with the virus of herpes indicates that the embryonic cells offer a more favorable condition for the growth of some viruses than adult chicken cells This embryonic tissue would therefore seem to be a promising medium to test the infectiousness of material from those animal diseases which have been proven to be or are supposed to be caused by viruses, but have not yet been transplanted upon an alien host

The great susceptibility of the chorio-allantoic membrane of chick embryos to infection with vaccine virus is shown by the readiness with which a vaccinal lesion develops and spreads on the membrane, and by the enormous multiplication of virus at the site of inoculation Bacteria-free virus has now been carried through many generations by passage every three days through the membranes of embryos ranging in age from seven to fifteen days The infected embryos rarely live longer than four days after inoculation because of the rapid spread of the lesion At the end of three days a large lesion has developed and this stage has been arbitrarily chosen as preferable for transfer, and for histological and cytological study

The technique of inoculation is the same as that recently described by Woodruff and Goodpasture,[1] except that we now outline the positions of the membrane in young embryos, 7 to 11 days old, by candling, so that we are sure the window will be cut directly over it. Also the surface of the egg shell is coated with a thin layer of melted paraffine over an area somewhat larger than the proposed window, in order to obviate infection from pieces of shell After the shell is removed the shell membrane is also coated with paraffine of low melting point so that this membrane may be torn with a sharp pointed instrument on three sides of the window, then folded back and cut with scissors, thus exposing the chorio-allantoic membrane. In this way powdered and fragmented egg shell can not so readily fall upon the exposed serosa and contaminate it.

Bacteria-free vaccine virus obtained from the testis of a rabbit has been used to initiate the infection.[2] When transfers are to be made from infected membranes the cover-glass is removed from the window, and the upper portion of the membrane is exposed as widely as possible by breaking off surrounding egg shell with aseptic precautions The infected membrane is then cut out and placed in a Petri dish containing sterile 9 per cent saline solution A small piece of tissue from the thickened and hemorrhagic area is removed with scissors and smears from this are stained by Morosow's method to determine the presence of Paschen bodies[3] These bodies appear in enormous numbers in the infected membranes although they are difficult to demonstrate in smears from the skin and cornea of chickens infected with vaccinia Their presence in the smear is diagnostic of infection Other smears are stained with Loeffler's methylene blue to determine the presence of bacteria If Paschen bodies are abundant and no bacteria are demonstrable a piece of infected membrane measuring from 5 to 1 mm in diameter is inoculated upon the membrane of each of five or six embryos We have found twelve day embryos to be perhaps most satisfactory Pieces of the remaining infected membrane are then inoculated into culture media and others are placed in 50 per cent glycerol in 9 per cent saline and in fixatives for histological study

---

[1] A. M. Woodruff and E. W. Goodpasture, *Amer. Jour. Path.*, 1931, 7, 209.

Sections of infected membranes fixed twenty-four hours in Zenker's solution and stained in a 2 per cent solution of acid fuchsin for ten to thirty minutes, then counter-stained with Loeffler's methylene blue and differentiated in absolute alcohol, present a most instructive picture Guarnieri bodies are found in all stages of development, finally filling and replacing almost completely the cytoplasm of the cell It is to be observed that Guarnieri bodies occur not only in the epithelial cells of ectoderm and endoderm, but in great abundance, reaching a relatively large size, in capillary and venous endothelium, in fibroblasts and possibly in the smooth muscle cells of blood-vessels It is to be noted that the inclusions develop in great numbers and to a large size before there is any necrosis or cellular infiltration, although inflammatory exudate is abundant in older necrotizing areas The effect of the infection on capillary endothelium is of interest The endothelial cells are frequently stimulated to an active multiplication, so as to form small nodules and cords completely obliterating the vascular lumens Petechial hemorrhages particularly from capillaries are numerous. The ectodermal cells of the membrane are affected first and apparently most severely, although there is often a more widely spread effect upon the mesoderm. Entoderm is affected least.

Smears made from infected membrane frequently show masses of partially dispersed Paschen bodies within the cytoplasm of cells, and pieces of membrane examined in distilled water show round or oval masses in which minute bodies are to be seen in rapid Brownian motion, just like those seen in the inclusions of fowl-pox and *Molluscum contagiosum* Studies are being made upon the relation of the Paschen bodies to the structure of Guarnieri bodies The abundance of both these elements and the unusually large size of the latter make this tissue especially adaptable to such an investigation

Virus passed through eight generations in chick embryos has been applied to the skin of two or three day old chicks after plucking the down Macroscopic nodules about 1 mm in diameter appear at the site of inoculation within three days Remaining apparently stationary for two or three days they rapidly recede Chicks recovered from vaccinia were infected two weeks later with fowl-pox virus and the lesions evoluted exactly like those of fowl-pox in normal chicks Vaccinia in the chick induces no immunity to fowl-pox

Our observations suggest that the chick embryo might be used advantageously for cultivating bacteria-free vaccine on a large scale for human vaccination

E W GOODPASTURE
ALICE M WOODRUFF
G J BUDDINGH
VANDERBILT UNIVERSITY MEDICAL SCHOOL

BOOKS RECEIVED

CRUM, RALPH B *Scientific Thought in Poetry* Pp vi + 246 Columbia University Press $3 00

FRASER, CHELSEA *The Model Aircraft Builder* Pp xi + 384 185 figures 14 plates Thomas Y. Crowell. $2 50

JACK, R LOCKHART *Geological Survey of South Australia.* Bulletin No 15 *Report on the Geology of the Region to the North and Northwest of Tarcoola* Pp 31 South Australia Department of Mines

KUNTZ, ALBERT *A Text Book of Neuro Anatomy* Pp xii + 359 197 figures Lea and Febiger $5 50

PORTER, ALFRED W *Thermodynamics* Pp vii + 96 21 figures Dutton $1 10

RICHARDSON, A E V, H C TRUMBLE and R E SHAPTER. *Factors Affecting the Mineral Content of Pastures* Pp 47 9 figures Council for Scientific and Industrial Research, Australia

ROSENHOLTZ, JOSEPH L and DUDLEY T SMITH *Tables and Charts of Specific Gravity and Hardness for Use in the Determination of Minerals.* Pp 83 Rensselaer Polytechnic Institute

SMYTH, CHARLES P *Dielectric Constant and Molecular Structure* Pp 214 31 figures Chemical Catalog $4 00

STYLE, D W G *Photochemistry.* Pp. vii + 96. 9 figures Dutton $1 10

WYCKOFF, RALPH W G *The Structure of Crystals.* Second edition. Pp. 497 271 figures. Chemical Catalog $7.50.

---

[2] A strain of Levaditi neurovaccine was kindly supplied by Dr T M Rivers

[3] M A Morosow, *Centralbl f. Bakteriol*, Pt. I, Orig., 1926, 100, 385

SCIENCE

Vol. 74 — Friday, October 16, 1931 — No. 1920

The Art of Medicine Professor David Riesman 373

Obituary

Edward Skinner King Leon Campbell. *Memorials, Recent Deaths* 380

Scientific Events

The Metallurgical Advisory Board, The Institute of Paper Chemistry, The Five Year Program of the Kentucky Geological Survey, Psychological Expedition to Central Asia 381

Scientific Notes and News 384

Discussion

Bilateral Gynandromorphism and Lateral Hemihypertrophy in Birds Professor Frank R Lillie *Anguillula Aceti—A Desirable Nema for Type Study*. Professor George Zebrowski 387

Scientific Apparatus and Laboratory Methods

Some Laboratory Uses for Crown Sealed Milk Bottles Dr. J Howard Brown. *A Dilatometer for Measuring the Swelling of Seeds* Professor M. A Raines 391

Special Articles:

Land Types of the Trinity Beds Professor G R. Wieland *Effect of H Ion Concentration on the Division Rate of Paramecium Aurelia* Austin Phelps *Induced Autotomy in Thyone* Professor Frank R. Kille 393

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City. Grand Central Terminal
Lancaster, Pa. Garrison, N Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C.

THE ART OF MEDICINE[1]

By Professor DAVID RIESMAN

PROFESSOR OF CLINICAL MEDICINE, UNIVERSITY OF PENNSYLVANIA

If I indulge to-day in a panegyric of the art of medicine, it is not with any intention to disparage the science of medicine. Far be it from me to do so I was trained in pathology and taught that fundamental branch for eight years before engaging exclusively in the teaching and practise of internal medicine. I may therefore lay some claim to an interest in the sciences. But I am here to-day through the courteous invitation of Dr. Locke to speak of medicine as an art by which is meant medicine as it applies to the care of the patient in contrast with medicine as a branch of the science of biology of which we proudly claim it to be a part. When I contrast the two branches of medicine—the art and the science—it must not be inferred that they are separable in the doctor's daily work. Dr. John Brown, the gentle author of "Rab and His Friends," long ago said that art uses one eye and science the other but wisdom uses both. It is for this wisdom arising through a union of science and art for which we must strive as students and as practitioners of medicine.

The art and the science of medicine are like the two sides of a shield, neither can exist alone, neither by itself can achieve the grand goal for which medicine has been striving through the ages—to relieve suffering and to prevent disease.

In its composite character of art and science medicine does not differ from some other occupations, from that of the blacksmith or that of the mason. I can illustrate what I mean by a story I once wanted a stone wall built from my house to the garage—a simple wall slightly curved. Any mason knowing the science of putting one stone upon another, of dropping a perpendicular, should have been able to do it. But upon inquiry I was advised to get an Italian mason because the Italians, so I was told, had a natural feeling for stone and would give me a more beautiful wall. And that is what happened—the wall is a work of art. It has something that the mason who only knows how to cut stone and mix mortar and pile one block upon another by the plumb line could not have achieved. And is not the same thing true, *mutatis mutandis*, of the doctor and of the blacksmith? There is science in everything and there is art in everything When the wool workers of Florence wanted to provide the baptistry with bronze doors, they established a competition The competitors were to make a panel depicting the sacrifice of Isaac by Abraham Brunelleschi and Ghiberti were the chief contenders and both fulfilled the requirements as to subject and size of panel It needs, however, only a glance at the two designs to reach an immediate decision in Ghiberti's favor His was the greater art Hence those wondrous gates that Michelangelo said were fit to be the gates of Paradise.

---

[1] Address delivered by invitation to the students of the Harvard Medical School, November 19, 1930

It is possible to fix an approximate date in history for the beginning of the science of medicine Some think it began in a feeble way with Herophilus of Alexandria. Galen, the 2000th anniversary of whose birth has recently been celebrated in Philadelphia, made a better beginning but after him the scientific or as we might also call it the experimental side of medicine slumbered for nearly fifteen hundred years, virtually until Harvey's discovery of the circulation of the blood in 1615

The art of medicine, the care of the patient on the other hand, goes back in an unbroken tradition to the very beginnings of the healing art It must have begun in what Dolley calls the dusk of prehistoric time Astronomy is the only branch of human knowledge that might vie with medicine in length of lineage. The spirit that has animated the art of medicine in these long ages is beautifully expressed in the name of the first physician recorded in history—the great Egyptian Imhotep, whose name means "He who cometh in peace"

What do we understand by the art of medicine? The phrase, as I have said, is largely though not wholly synonymous with that of the care of the patient In actuality, however, it has a much wider connotation for it concerns itself not only with the sick individual but with the totality of his environment—his family, his friends, his occupation, his social and pecuniary status, indeed with everything that can favor or retard his recovery from illness In the past we have taken a too narrow view of our task in caring for the sick human being for we have been interested only in the patient or in his disease Largely through the work of Dr Richard Cabot and his school a wider horizon has been opened to us with incalculable benefit to the sick and with a nobler position of the art of medicine We have come to realize that it is not sufficient to prescribe for the patient and to lay down rules for his diet, for his time of rest and of work We must go beyond these undoubtedly necessary matters and learn the conditions at home, whether the diabetic patient is getting the right diet, whether the child is getting the needed food and sunshine, whether the conditions of living are made suitable for the nervous and maladjusted patient We must remember the influence of sickness upon dependency and delinquency, the demonstrated relation between these is an added spur for giving to the patient's relation to the outside world every possible thought and effort

I can not leave this phase of my theme without paying a tribute to the social workers whose cooperation has so greatly facilitated in our day the care of the patient

The principles of the healing art have not greatly changed since the beginning although the advance of civilization has brought about certain modifications in practise, for example, in the care of the insane and in the control of epidemics The irrational attitude of the public and even of the profession which until recent times expressed itself, *e g*, in shot-gun quarantine against yellow fever, was due to ignorance and has been abandoned Perhaps our present methods of quarantine against some of the contagious diseases are also based on false premises and will eventually disappear

There are other noteworthy advances in the care of the sick that deserve a moment's notice The fever patient is no longer smothered with blankets and suffocated in an hermetically sealed room We have insulin, liver and arsphenamine for the treatment of three important diseases But lest we become too vain, let me remind you of quinine for malaria, introduced into Europe just three hundred years ago, of vaccination against smallpox, 134 years old, of lime juice against scurvy (1770), of ether for anesthesia (1846) and of antisepsis against wound infection (1847), all of them initiated or developed before any one here was born

I do not think I shall be challenged if I say that in his medical course as at present constituted the young student learns too little about the care of the patient In certain places there is indeed a definite tendency to minimize the importance of the art of medicine and to imbue the student with profound faith in the laboratory as the Alpha and Omega of medicine I doubt whether Hippocrates, incomparable observer that he was and wise above other men, could get a chair to-day in some of these superscientific medical schools The first question that would be asked of him would be—"How long have you worked in a laboratory?" And I can see a fine tolerant smile playing about his sensitive lips as he replies, "I have done no laboratory work but I have studied disease diligently at the bedside. I know its constants and its vagaries. I know how to treat it."

Speaking of Hippocrates I am reminded that our medical schools not only neglect to some extent the practical aspects of the treatment of the sick but they also fail to touch that phase of the care of the patient upon which the Hippocratic school laid such stress, namely, prognosis. And yet the reputation of a physician often stands or falls more by his prediction than by his treatment

Perhaps the care of the patient receives more consideration here at Harvard than elsewhere, because it is in this school that the traditions of Francis Peabody are felt and honored In his beautiful swan song, "The Soul of the Clinic," Peabody has expressed in admirable language the true ideals of the teacher of the art of medicine

The care of the sick can not be learned from books It must be learned at the bedside, in the hospital or in the home Harvey Cushing tells of a young physician who counted as the most valuable experience of his ten years of medical study a summer's substitution for a local doctor among an island colony Never before had his powers of observation and his common sense been so thoroughly exercised Although some hold differently, I believe that no one can become a great specialist who has not had some kind of practical bedside experience There was much good in the old preceptorial system under which the young doctor accompanied the old doctor on his daily rounds and learned the art of medicine under a teacher who knew it I am naturally much interested in the Wisconsin experiment of reviving this old custom

As the result of the unilateral teaching of which I have just spoken, the student goes out into practise with the conviction that the laboratory is of supreme importance and that observation and study at the bedside are of secondary rank Such blind dependence upon laboratory methods makes many otherwise excellent men of little use in the treatment of the sick This fact was brought home to me and many others during the war Men thoroughly familiar with laboratory technique but lacking the clinical spirit were, in the beginning at least, of little help in the wards during the influenza epidemic.

I recently asked a renowned artisan in wrought iron why the world was no longer able to build great Gothic cathedrals like that of Chartres "To-day," he replied, "men are draftsmen, in those days they were craftsmen" This subtle distinction is applicable to the two types of medical men—the theoretically trained draftsman and the all-around doctor craftsman.

The tendency to ignore the human side of medicine in the patient through a predominating interest in his disease and in the laboratory reached its height in Germany, but lately the pendulum has begun to swing in the opposite direction and now one hears everywhere the slogan, "Back to Hippocrates." What is meant by this cry, back to a man who was born 460 B C? It means that medical men are coming to realize that in their otherwise laudable zeal for scientific methods, they have forgotten the true essence of their calling—the healing of the sick. Heilwissenschaft had displaced Heilkunst

After these not wholly unnecessary digressions, I shall take up in detail the mixture of elements that constitutes the art of medicine I shall first consider the subjective side of the art, that which deals with the personality of the doctor, and then the objective, which deals more directly with the care of the patient

All writers of romance have put in the foreground of the ideal doctor's qualities sympathy I am not altogether in agreement with these well-wishers or critics of our calling, for to me the most important quality in a doctor is understanding—the ability to fathom the psychology of the patient Much of the good occasionally accomplished by the misguided followers of Mary Baker Eddy can be ascribed to an understanding of the human mind and of its influence upon the body

The fact can not be disputed that the newer psychology especially psychoanalysis has sharpened our powers of understanding the subconscious mind and has given us a valuable means of treating certain types of nervous and mental diseases I believe our medical schools are delinquent if they do not teach at least the elements of analytic psychology as it applies to the neuroses, to the psychoses, and to the problem child

The quality of human understanding comprises the quality of sympathy Sympathy, at least the active kind, is not always in place, for certain patients, the utterly selfish ones, frequently are best treated somewhat roughly But under all circumstances the doctor must have pity, "I can not live without pity if I am to become a doctor"

Two other closely related qualities help to give the doctor personality—ambition and enthusiasm They are prerequisite to self-improvement The doctor who has them will be what every doctor should be—a student all his life I like it when the doctors talk shop. My lawyer friends, I find, rarely talk law nor do they seem to read as many journals and magazines as the medical men. A physician who reads knows what is being done in Boston, Berlin, Brussels, Helsingfors, Frankfurt, Rochester and Vienna The lawyer's intellectual contacts seem to be more limited, that is why I think medicine is a much better field than the law. While I proclaim this self-evident truth I nevertheless have a very high respect for the lawyer who with equal conviction holds the direct opposite The doctor's attitude as well as the lawyer's toward his calling must be like that of the blacksmith in "Daniel Deronda" who said, "For the life of me I can not see why anybody wants to be anything else but a blacksmith"

Next to understanding in importance comes confidence—confidence primarily in one's self for only he who possesses it can inspire confidence in others, and in the relation of doctor and patient confidence is everything The author of San Michele asks, "What is the secret of success?" and answers, "To inspire confidence" Confidence is a magic gift granted by birthright to one man and denied another The doctor who possesses this gift, says Axel Munthe, can almost raise the dead The doctor who does not possess it will have to submit to the calling in of a colleague in consultation in a case of measles

Experience and knowledge are the foundations of self-confidence In their absence conceit may perhaps create self-confidence but it is then like an inflated bubble easily pricked

Confidence in one's salf begets imperturbability—a magnificent asset in the crises of the sickroom When the patient is in agony and the friends in despair the calm, well-poised, confident doctor is like a tranquil haven to a storm-tossed ship

The doctor needs to be honest—I do not mean the vulgar honesty that the Philadelphia Quaker had in mind when he said to his son, "Be thee honest, James, but if thee can't be honest, be thee as honest as thee can" I mean intellectual honesty, the kind that scorns deceit and bluff

The thought of intellectual honesty suggests another thought and that is the danger, the unwisdom, of becoming a fashionable doctor A few years ago I called on a very distinguished physician in Harley Street in London During the course of conversation I asked him about another man on Harley Street who is widely known as a clinician "Oh," he said, "he is just a fashionable doctor" His tone spoke volumes What he meant I am sure you can all imagine

There are other elements that can not be left out of the category of qualities a doctor needs if he wants to exercise the art of medicine with success Dignity is one of these. The dignity I have in mind does not depend on what is facetiously called the bedside manner, nor upon the cut of the clothes, nor upon the appointments of the office I can best define it by saying what is absent from it—familiarity, gossipiness, pomposity and haste

When I began the practise of medicine a young man had a hard time to succeed. My contemporaries and I were sure that the Vandyke beard, the frock coat and a few gray hairs were the *sine qua non* of success. As a concession to this sentiment, I grew a beard but as it was red and my hair was brown, the combination was by no means comely and I soon took the advice of well-meaning friends and of the looking glass and did away forever with the beard.

Punctuality, the politeness of kings, is a quality of much value in the doctor's relation to his patients and his colleagues The patient has little patience. The late Dr William Pepper, one of the busiest men of his generation, was remarkably prompt Not only must a doctor be punctual but he must never appear to be in haste It was one of Sir James Mackenzie's striking characteristics that no matter how pressed he was for time he never seemed hurried

The doctor must have courage—a courage greater than that of the soldier who is sustained by the thrill of battle and the inspiring support of his fellows. The courage of doctors in all ages has never been surpassed There are, of course, instances of lack of courage but they are few You may remember that the great Thomas Sydenham was accused of deserting his practise when the plague broke out in London. It is told of Galen that he was once asked by Marcus Aurelius to accompany him on his campaign in Germany Galen immediately had a very convenient dream in which Aesculapius forbade him to leave Rome, a divine command Marcus Aurelius did not dare to disobey.

I am not fond of the praise of those who sympathize with the physician because he has to make many sacrifices of those joys and activities of life upon which the average mortal sets so high a store. "Doctor, it must be hard for you to miss that opera, this play or that party" No, it is not at all hard except perhaps through the uxorial reflex, for the thing we do instead brings so much more durable satisfaction. Some wives may perchance express regret, but the ideal wife which nearly every doctor has shares her husband's feelings.

And now I come to the objective aspect of the care of the patient—the practical application of the art of medicine.

The visit of the patient to his doctor is an event of transcendent importance upon which the patient focuses all his thoughts, his hopes and fears. He is full of his story and wants to pour it out to a receptive listener The doctor, therefore, must listen with patience and interest, he must avoid interruptions and when interruptions come, he must from a cultivated habit be able to bring back his mind at once to the patient's case.

The doctor must be a detective, a Sherlock Holmes, a Zadik, so as to elicit data intentionally or unintentionally concealed by the patient.

He must understand something of the laws of heredity which play a more important rôle in the majority of diseases than is dreamt of in our everyday philosophy Furthermore, he must have some acquaintance with the newer concepts regarding the constitutional factors in disease, factors that are closely allied to heredity.

Study of the recent literature and bedside experience are the chief teachers in these newer but worthwhile fields.

After obtaining, often with infinite pains and self-control, the history, the doctor proceeds to make the physical examination It is at this point that art and science meet. The doctor must know his tools, whether they be his hands, his eyes, the test-tube or the microscope He must know how to make a physical examination He must know the physiognomy of disease so as to recognize it when it is present

After a thorough examination and a painstaking history, he should be able to arrive at a diagnosis and to apply treatment rationally

Let your work be so thorough that when the patient leaves your office he will be able to say, "Such an examination I have never had before."

The subject of physical examinations reminds me to say a word about the cost of medical care, especially about the cost of laboratory examinations. Is it not the duty of every physician to minimize the expense to which the patient might be subjected by avoiding useless and uncalled for examinations? Expensive wholesale examinations not based on a thorough preliminary study are economically wasteful and reflect grievously on the good sense of the medical profession. Much of the criticism of the cost of medical care arises from this wide-spread practise of ordering indiscriminately all manner of examinations in every patient.

Medicine after all is not a matter of trial and error nor is the doctor's examination a *ballon d'emblée* but it is a purposive rational procedure based on a careful history and on an appreciation of the needs of a given case There are occasions when difficulties of diagnosis may warrant the making of every possible test but they are rare.

What should the doctor tell the patient about his disease? There are some distinguished men who urge that the doctor tell the truth, the whole truth and nothing but the truth I am inclined to think that those who give this advice have never had any desperate illness in their own families or at least have seen but little suffering among the people. When Dante inscribed above the doors of his "Inferno," *Lasciate ogni speranza voi ch'entrate*—all hope abandon ye who enter here—he showed his profound understanding of the human soul. He knew that the greatest thing men live by is hope.

The doctor must ever be careful not to banish hope even at times when there seems no hope. Does that mean to be false to truth? No, it only means that the doctor should temper his statements so as not to crush the spirits of the patient or his dear ones. There are cases that by every criterion are doomed, in which nevertheless a sudden turn may occur and recovery result One not rarely hears the statement—the doctors had given him up but he got well

I have seen recovery in cases of insanity that seemed utterly hopeless A woman comes to my mind at this moment who had a profound melancholia She tore out her hair, had to be fed forcibly and took on the appearance of an old hag After about three years of abject and repulsive negativity, she began to improve and finally got entirely well, so well that she has been able to make several trips to Europe and one around the world

But even in cases that experience tells us can not possibly recover, the humane doctor will so couch his statements that the family will be sustained during the last days or weeks of the patient's life

A patient of mine had a serious coronary attack and seven years later had a second one while in Paris The physician in attendance called a consultant who as soon as he had seen the patient said to the wife, "Madame, your husband is going to die." Put in that bald brutal way the dictum crushed her She implored the attending physician to remain with her husband and to spare no efforts to save him. To every one's astonishment the man improved, so that the consultant on his next visit declared that he had been in error and that the patient would now recover. The wife was overjoyed. That night the man had another seizure and died

What should the doctor have said? As I see the situation he should have said something like this: "Madame, your husband is very ill, his chances of recovery are not good. However, we shall not give up and shall do everything in our power to save him"

The question is often asked, "Doctor, shall I send for the children?" I usually reply, "It might be wise; if they find their father improved, they will be only too happy and if not, they will be grateful for letting them know the truth."

Keep the patient's confidence. If you get to be known as one who babbles, patients will keep from you important details of their lives that you need to know if you want to be successful in your treatment.

Coming now to specific advice on the question as to what to tell the patient, my counsel has been somewhat as follows.

If the patient has a serious disease, the knowledge of which might frighten or crush him, tell him the whole truth only if it is otherwise impossible to get his full cooperation. If he carries out the instructions faithfully, it is unnecessary, it is cruel to tell him the worst

In the case of tuberculosis conditions are somewhat different A patient who does not know his disease may become a menace to others Moreover, in the absence of an understanding of his malady he will rarely give that full cooperation which is vital for success in conquering the disease Therefore, I always tell the patient the truth if he has tuberculosis One need not be brutal about it—one can sugar-coat the pill but the pill must be administered

Many patients have cancerophobia, that is they are convinced that somewhere in the body there is a cancer If after a thorough examination I have come to the conclusion that there is no cancer, that the fear is groundless, I have sometimes found the following procedure very successful If after the examination the patient asks me, "Doctor, do I have a cancer?" I say, "Yes, you have two or three" That generally causes him or her to smile and the fear vanishes

If for legitimate reasons one conceals the true nature of a grave disease from the patient himself, one must as soon as possible apprize a member of the family Not only is this a duty one owes to the family but it is also a matter of self-protection, otherwise the doctor may be accused of not having known the true nature of the patient's illness

It is the doctor's duty if the patient has an illness that might suddenly terminate his life, such as angina pectoris, aneurysm, or excessively high blood pressure, to induce him in a tactful way to make his will

In a doubtful case the doctor must always err on the side of hope but he must be honest not to rouse vain expectations when he is fairly convinced that the patient can not recover

In connection with this general subject there is a kindred matter of which I want to speak There are situations in which from the nature of things treatment is useless If the case is one of long-standing suffering, such as cancer, the family nearly always prefer that the doctor do nothing to prolong the agonal period They may, in fact, resent the torturing with injections of an already overtortured patient There are cases, however, in which the family insist that the doctor spare no efforts, that he fight with death to the last moment They resent it if he sits idly by with folded hands while the patient's life is ebbing away What is his duty in such circumstances? If the family is an intelligent one, he can explain the futility of all further efforts, but where intelligence is conspicuous by its absence, it is good psychology to keep on Only he who in the lonely hours of the night has fought with death over a dying child and has seen the gratitude in the eyes of the parents, knows the profound difference between theory and practice.

It is the doctor's duty to pay attention to the creature comforts of the patient The poorer the patient, the more important it is for the doctor to give that phase of the medical art his attention

Among the comforts of the patient the first place is occupied by a good nurse whether hired or "owned" A good nurse will see to it that the bed is clean and smooth, that the pillows are properly arranged—the arranging of the pillows is an art—that the light is satisfactory and the hangings not too garish The importance of the hangings was brought home to me many years ago in connection with a typhoid fever patient whom I had seen in consultation The young woman was convalescing from her fever but had become wildly delirious, crying out that she was being burned alive The family and the doctor were greatly worried that her mental aberration might be permanent However, I gave a good prognosis and outlined appropriate treatment I did not see the patient again, but perhaps six months later a young woman walked into my office and said, "Doctor, I want to pay my bill" I did not recognize her She said, "I am Miss Nichols Perhaps you would like to know something about my delusions." "Surely," I said, "I remember the details very well" Then she told me that she attributed her delusions of fire and burning to the fact that the wall paper was red, red flowers were being sent to her, the screen around the bed was red and the nurse was fanning her with a red fan

It goes without saying that proper food properly prepared and properly served is vitally important. Unfortunately even in the best hospitals one or more of these factors may fail

A point of importance often neglected is the giving of specific directions Early in my life I found it a good practise to write out for the caretaker, whether it was a member of the family or a nurse, the directions as to food, medicines, etc.

This applies also to prescriptions It is unwise to say "take medicine as directed" The instructions should be specific and if the medicine is to be used externally, be sure to say "for local or external use."

Whatever treatment is instituted must be made to fit the patient's circumstances It shows the doctor's lack of understanding and judgment if he suggests methods of treatment that the patient's station in life makes impossible of application If the doctor in this year of grace should suggest to a broken-down broker that he go to the French Riviera for his bodily health, it might lay him open to a great deal of ridicule

Visits of friends. Job's comforters are so ubiquitous that the majority of patients are better off without visitors although one must use judgment. Recently one of my patients, a man 69 years old, had his tonsils removed. It was quite a shock to him As he was convalescing and about ready to go home Bildad the Shuhite came to see him in the person of a business friend and told him this—"Don't go home too soon, a man I know went home the other day and had a terrible hemorrhage and nearly died"

Attendance at operations Many a patient who is about to undergo an operation scarcely knows the surgeon when the latter is in his civics and not at all when he is garbed like a member of the Ku Klux Klan What a comfort it is to have the family doctor standing by his side when the anesthesia is about to begin

There is also a personal advantage to the doctor in being present at operations and that is he can learn a great deal more from the *autopsia in vivo* than from books.

Be present at death, it is a great comfort to the family who may need the staying influence of a sympathetic friend, one whose countenance like that of Conan Doyle's Dr Seldon is in itself a consolation

In discussing treatment of any given disease textbooks and teachers of medicine usually dwell upon the treatment of the disease during its course Little attention is given to the treatment during the period of convalescence and yet that is a very important part of therapeutics If the patient is recovering from some acute infectious disease like influenza, pneumonia, or typhoid fever, he can not return to work immediately, he has first to get back his strength, both mental and physical He must receive instruction as to how much to sleep, how much to exercise, what to eat, in fact, how to live until he is himself again

I have found that many surgeons entirely neglect the after-treatment of their cases That neglect accounts for a certain proportion of recurrences or post-operative failures If the surgeon will not take the trouble to instruct the patient how to live after a capital operation, then the medical man must be prepared to give the necessary advice. He must prescribe the patient's diet and his general course of life. I want to pay tribute to one of your fellow citizens who has done a great deal to focus the attention of the profession on the after-care of patients—Dr. John Bryant

I often advise women patients who are convalescing to get up, put on corsets, stockings and the best dressing gown they possess. It will give them a sense of well-being As Emerson understandingly expressed it, "The consciousness of being well-dressed is capable of yielding satisfaction that religion is powerless to bestow."

An essay on the care of the patient might properly include a section on that ticklish subject called medical ethics.

Among the lay public ethics commands about as much respect as the Volstead act in Chicago. They look upon our code as a sort of conspiracy for their undoing That is because they do not understand it and also because sickness creates selfishness Our ancient code is nothing more or less than a system of honorable dealing and in the last analysis is advantageous to the patient

Much criticism is heard about consultations Some of it is justified, although the strictures of Molière and the caricatures of Cruikshank hardly apply today I believe in open consultations openly arrived at and whenever possible try to persuade the attending physician to have the family present

I have known the doctor in attendance in cases in which there was a radical difference of opinion to ask the consultant to tell an untruth That is unfair both to the patient and to the consultant If the consultant is tactful, he can express his opinion without belittling or embarrassing the family physician

And now, in concluding, I want once more to make it plain that indispensable as bedside experience is, it alone does not make a good doctor and if the Hippocratic ideal implied only bedside study, only the art of medicine, it would be an inadequate ideal Believing this I have not been able to follow the late Sir James Mackenzie, for whom I had the highest personal regard as doctor, scientist and pioneer cardiologist, in his vehement attack on laboratory methods—an attack difficult to understand in one who in his early years made use of precision instruments with the greatest advantage to medicine I can explain it only on the ground that many a great man when he grows old becomes a *laudator temporis acti*.

There is no conflict between the bedside and the laboratory Indeed the bedside may also be considered a laboratory The problems of clinical medicine, of bedside research, are as unlimited as are the problems of laboratory research and to my mind a good conscientious clinical essay is as valuable a contribution as a laboratory essay, even if that is filled with quadratic equations and estimations of the pH to the tenth decimal.

The physician who would be an artist in medicine must, like the artist mason of whom I have spoken, have the fundamental skill or science to build on. His foundations must be solid and he must understand the use of plumb and level Bedside manner otherwise becomes a mere veneer

A doctor must not only read medicine, if he has ambition and enthusiasm he will read much else besides. Everything that extends his antennae makes him a better physician For that reason I am an ardent advocate of a hobby for every medical man. A hobby has a subjective value—it is a haven of rest for the tired mind, and it has an objective value in that it gives additional points of contact with intelligent patients and may form the basis of brief conversation that adds to the pleasure of the doctor's visit It may even lead to friendships that otherwise would not be formed.

The American is what Paul Leicester Ford calls Peter Sterling, a practical idealist Better perhaps than any other national he can combine the ideals of the art of medicine with the ideals of the laboratory. Under that combined egis medicine will become a greater and a grander profession, more scientific in the sense of understanding better the physiologic basis of life and health and a nobler art in its profound insight into the human soul which can not be weighed in the balance or seen through the microscope

OBITUARY

EDWARD SKINNER KING

On September 10 Professor Edward Skinner King, astronomer for more than forty years at the Harvard College Observatory, died at his home in Cambridge, Massachusetts, after a short illness He was born at Liverpool, New York, on May 31, 1861, and obtained his education in the schools of that state, receiving his degree from Hamilton College an A B degree in 1887, an A M in 1890 and an honorary Sc D in 1927 While at Hamilton he specialized in mathematics and the classics, taking several of the coveted prizes in mathematics, and was elected a member of Phi Beta Kappa.

During his college days he came under the guidance of Professor C F W Peters, upon whose suggestion he applied, immediately following his graduation, for a place on the staff of the Harvard College Observatory Appointed an assistant in 1887, he was connected with the observatory thereafter almost continuously until his death There was an interval of about three years in the early nineties when he was compelled to give up active duty because of ill health

During all these years Professor King was in charge of astronomical photography at Cambridge, developing new methods of clock control, instrumental guiding and plate testing He was a pioneer in the subject of photographic photometry, and made a special determination of color differences in stars, as observed photographically and visually He was the first successfully to photograph the Aurora and the spectrum of lightning, and was likewise the first to observe star occultations by photographic means The results of his scientific work are to be found in the various Harvard Observatory publications and include, among others, discussions on the absorption of photographic wedges, photographic photometry, lunar photometry, tests of photographic plates, transformation of prismatic to normal spectra, absorption medium in space, out of focus results on magnitudes of stars, eclipses of Jupiter's satellites, and photo-visual magnitudes of stars and planets

For more than ten years Professor King contributed biweekly articles on astronomy to one of the prominent newspapers of the country, and in this connection devised and published his "Star Maps" He was coauthor of the "Harvard Radio Talks," better known as "The Universe of Stars" In 1930 he produced his "Manual of Celestial Photography," an authoritative and unique treatise on how to take celestial photographs

Professor King became assistant professor of astronomy in 1913, and in 1926 was made Phillips professor, a chair which he held until September first of this year, when he became professor emeritus. He was a member of numerous scientific societies, among which were the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the International Astronomical Union, the Société Astronomique de France, the Bond Astronomical Club, the Nantucket Maria Mitchell Association, and the American Astronomical Society, of which, at the time of his death, he was a member of the council.

He was married in 1890 to Miss Kate Irene Colson, of Batchellerville, New York, to whom three children were born: Dr Harold Skinner King, now associate professor of chemistry at Dalhousie University, Halifax, N. S, Margaret W, wife of Professor J C. Manry, of the University of Iowa, and Everett T., who died in 1917.

Leon Campbell

MEMORIALS

To celebrate the centenary of the British Medical Association the council has opened a fund for the purpose of establishing a permanent memorial to its founder, Sir Charles Hastings The *British Medical Journal* reports that the memorial will take the form of a stained-glass window in the cathedral at Worcester, a city with which he was intimately associated all his life; the placing of a tablet on the house in Worcester in which he practised, and the restoration and permanent upkeep of his grave in the Astwood Cemetery, Worcester. Any balance left over after these objects have been fulfilled will be given to the Sir Charles Hastings Fund, which is controlled by a small body of trustees, who have power to distribute the income for the benefit of individual members of the profession or their dependents in any way that the trustees may think fit. The fund has proved exceedingly useful in cases which do not come within the ordinary scope of the Royal Medical Benevolent Fund and in cases in which there is urgent need for help

RECENT DEATHS

Dr L L Van Slyke, chemist at the New York State Agricultural Experiment Station at Geneva and professor of dairy chemistry at Cornell University, died on October 1 He was seventy-two years old

Dr Willis A Slater, director of the Fritz engineering laboratory at Lehigh University and formerly engineer physicist at the U S Bureau of Standards, died on October 6 at the age of fifty-three

Dr George Thomson Elliot, emeritus professor of dermatology at Cornell University Medical College, died on September 14 Dr Elliot was seventy-six years of age

Mr Alfred J Henry, senior meteorologist in the U S Weather Bureau and editor of the *Monthly Weather Review*, died on October 5, aged seventy-three years

Dr James W Gidley, assistant curator of fossil mammals at the U S National Museum, died on September 26 He was sixty-five years of age

Dr J Madison Taylor, professor of physical therapeutics and dietetics at Temple University, died on October 3 at the age of seventy-seven years

Professor Josiah W Votey, dean of the College of Engineering at the University of Vermont, died on September 16, at the age of seventy-one years

Mr Andrew J Wiley, well-known consulting engineer, died on October 7 He was sixty-nine years of age

Sir William John Ritchie Simpson, director of tropical hygiene at the Ross Institute, Putney, editor of the *Journal of Tropical Medicine*, and emeritus professor of hygiene and public health at King's College of the University of London, died on September 20, at the age of seventy-six years

Dr Percy Groom, professor of the technology of woods and fibers at the Imperial College of Science and Technology, died suddenly on September 16 Dr Groom was sixty-six years of age

Colonel the Honorable Milo G Talbot, who was awarded a Royal Medal of the Royal Geographical Society in 1909 and who was known for his surveys of the northwest frontier of India and Anglo-Egyptian Sudan, died on September 3 at the age of seventy-six years

SCIENTIFIC EVENTS

THE METALLURGICAL ADVISORY BOARD

The fifth annual open meeting of the metallurgical advisory board to the Carnegie Institute of Technology and the U S Bureau of Mines will be held on Friday, October 16, on the campus of the institute, in Pittsburgh The progress made on research problems undertaken jointly by the Carnegie Institute and the U S Bureau of Mines will be discussed during the morning and afternoon sessions by investigators from the two laboratories

Mr Charles F Abbott, executive director of the American Institute of Steel Construction, Inc, will be the principal speaker at the evening session, which will follow an informal dinner at the Hotel Schenley Mr. Abbott's subject will be "Market Research in the Steel Industry" Dr Thomas S. Baker, president of the Carnegie Institute of Technology and organizer of the advisory board, will preside at the evening session.

The morning meeting will be devoted to reports and discussions on iron-manganese-carbon alloys and chrome-nickel alloys. Reports on research work will be given by Dr Francis M Walters, Jr, director of the Bureau of Metallurgical Research of the Carnegie Institute, Dr. V. N. Krivobok, metallurgist of the same bureau, and Maxwell Gensamer and Cyril Wells, assistants Dr C H Herty, Jr, physical chemist, and M B Royer, assistant metallurgist, of the U S Bureau of Mines, will deliver a report on the solubility of carbon in iron-manganese-silicon alloys Dr G R Fitterer, associate metallurgist of the U S Bureau of Mines, will report on the electrolytic method for the determination of inclusions in steel Other reports will be delivered by the same investigators

The physical chemistry of steel-making will be reported on and discussed at the afternoon session The three outstanding contributions from this work are the development of a new manganese-silicon deoxidizer, which has been shown to be much superior to ferro-manganese ferro-silicon in combination in producing clean steel at a low cost, the development of a method for quantitatively determining non-metallic inclusions in plain-carbon steels, and the determination of the factors which affect the oxidation of steel in the open-hearth furnace. These reports will be made by Dr. Herty and members of the staff of the U S Bureau of Mines The several reports will be interspersed with discussions by metallurgists from the industry.

The laboratories of the U. S. Bureau of Mines and of the Carnegie Institute of Technology will be open for inspection on the morning of October 17. Members of the staffs will be present for informal discussions on the work which is being done

THE INSTITUTE OF PAPER CHEMISTRY

THE new building to house the Institute of Paper Chemistry at Lawrence College, was dedicated on September 23 We learn from *The New York Times* that an announcement was made of a gift of $100,000 to the institute by Mr J C Kimberly, president of the Kimberly Clark Company, in memory of his father, Mr J A Kimberly, who was among the first students to enter the doors of Main Hall at Lawrence College when it was built, more than seventy-six years ago The elder Mr Kimberly was for half a century a pioneer in the pulp and paper industry

In the words of Mr Ernst Mahler, president of the institute and a vice-president of the Kimberly Clark Company, "the gift will be used to erect, contiguous to the present building, a library and laboratory to house the splendid collection of books we possess and to make provision for its growth, and to provide additional laboratory space, already shown desirable"

Other gifts of $15,000, to be made available for additional fellowships and scholarships for institute students during the next three years, were also announced

President Herbert Hoover sent a letter of commendation to Mr Mahler on the organization of the institute The program at the dedication began with a procession of the faculty of Lawrence College, with which the institute is affiliated, and included the presentation by Mr Mahler of the keys of the institute to the president of Lawrence College, Dr. Henry M Wriston, who paid tribute to the "enthusiastic and energetic labors of the members of the board of trustees"

Dr John H Finley, associate editor of *The New York Times*, in the dedicatory address congratulated Lawrence College, a liberal arts institution, on its having an affiliated graduate school to be devoted completely to the interests of research in the pulp and paper industry.

The ceremony brought a number of the leaders of the pulp and paper industry to Lawrence and the institute. Guests at a luncheon held in connection with the dedication included Mr M A Krimmel, chief chemist of the Hammermill Paper Company and president of the Technical Association of the Pulp and Paper Industry, Colonel Benjamin E Franklin, president of the Writing Paper Manufacturers' Association and vice-president of the Strathmore Paper Company of Massachusetts, and S. L. Willson, president of the American Pulp and Paper Association. In their addresses they praised the institute as a means of supplying a much-needed technical training for newcomers in the industry and lauded the men who have pioneered in its founding

The school is patterned after the Darmstadt school in Germany and is the only one of its kind in the United States Several large grants were given when it was organized, and twenty-six students from universities throughout the country entered classes in 1930, under a faculty of nine Complete paper-making processes are studied

The purpose of the institute is threefold—to train talented college graduates in pulp and paper chemistry, to establish a comprehensive research library and information service for use of the paper industries and institute, and to coordinate research in the interest of the whole industry

Opened first with Dr Otto Kress as technical director, the institute has begun its new session with twenty-seven students, graduates of twenty-two colleges and universities and residents of sixteen states

It operates on a budget equal to the income from more than $1,000,000 endowment

About $250,000 is invested in the plant and apparatus, the institute having in its new building the finest arrangement of optical instruments, the most exact constant-humidity and constant-temperature rooms to be found, it is said, in educational institutions in America More than 225 mills and corporations throughout the United States have contributed instruments, materials and apparatus for use in its construction and operation

THE FIVE-YEAR PROGRAM OF THE KENTUCKY GEOLOGICAL SURVEY

THE Kentucky Geological Survey has just brought to completion its five-year program of detailed mapping of the areal and structural geology of the Blue Grass Region of Kentucky. This portion of the state—one of the choice agricultural areas of the entire country, is equivalent to the Ordovician exposure of northern-central Kentucky. In this region new base maps have been prepared at the scale of one inch to the mile, utilizing topographical surveys wherever possible for each of the counties involved. On these new county maps the areal and structural geology has been executed and with the completion of the map of Scott County, which is now shortly to be issued, new inch-to-the-mile areal and structural maps have become available for all parts of the Ordovician exposure in the northern-central part of the state. The following county maps have been prepared and have been issued separately: Boone, Kenton, Campbell, Gallatin, Grant, Pendleton, Bracken, Mason, Fleming, Nicholas, Bath, Harrison, Owen, Carroll, Trimble, Oldham, Henry, Franklin, Shelby, Jefferson, Spencer, Bullitt, Nelson, Washington, Marion, Boyle, Mercer, Anderson, Woodford, Fayette, Jessamine, Garrard, Lincoln, Madison, Clark, Montgomery, Bourbon, Robertson and Scott

While it is true that some of these maps overlap the periphery of the Blue Grass region and extend into the well-known Kentucky Knobs region, it is a fact there are to-day no areas within the Blue Grass which are not surveyed These new county maps are available to the general public for a nominal sum from the office of the Kentucky Geological Survey at Frankfort, Kentucky

With the exception of Garrard, Woodford and Fayette, all these county maps have been published by lithographic processes in standard colors on the scale of one inch to the mile. The usual divisions of the Kentucky Ordovician, ranging from and including the Richmond of the Upper Cincinnatian through to the High Bridge of the Champlainian, have been shown by outcrop This area encompasses about 8,000 square miles and constitutes the largest unit outcrop of Ordovician sediments mapped areally and structurally in detail in the world.

PSYCHOLOGICAL EXPEDITION TO CENTRAL ASIA

In July, 1931, the Uzbek Research Institute of Samarkand, together with the Moscow Institute of Experimental Psychology, organized the first expedition of the Soviet Union for the study of psychological characteristics of peoples in various stages of cultural development. The aim of the expedition was to investigate the variations in thought and other psychological processes of people living in a very primitive economic and social environment, and to record those changes which develop as a result of the introduction of higher and more complex forms of economic life and the raising of the general cultural level

One special task of the expedition was to develop new methods for evaluating intellectual status of individuals in very backward communities, because the usual methods of determining intelligence are inapplicable in the very special cultural conditions influencing the intellectual processes of the members of these groups. Another task was the preparation of educational methods which could be applied to these communities, such as the teaching of counting, reading, etc.

The expedition was organized under the direction of Professor Alexander Luria, of Moscow. The members of the expedition included Mr P I Leventuev, Mr. V. N. Arbuzov; Mr. V. V. Zaharova, Mr. H Ashrafi; Mr. A. Baiburova; Mr. L. S Gazaryans, Mr A. D. Kolbin; Mr. E. N. Mordkovich; Mr. H. Hakimov; Mr M. Hodzinova, Mr. F. N Shemyakin; Mr A A Usmanov, and Mr R. Yussupov

Before the expedition entered the territory, a two-months' seminar was conducted by Professor Luria in Samarkand in May and June, 1931, in which special topics were assigned, methods studied, and preliminary projects were carried out

The expedition began its work in Uzbekistan with the native population The chief work was done in the Alai Mountain region, and in the districts (*Kishlaks*) of Shahimardan, Yordan and adjacent uplands, where the people live under primitive nomadic conditions The control territory was the region of the River Narin (Kishlak Utch-Kurgan), which has a very active cotton-raising industry and highly developed collective farming, but with a population still backward culturally

Special attention was given to those socio-historical factors which influenced the development of the various stages of culture, and especially those changes which came as a result of the economic renascence of Central Asia For the purposes of the research both territories were found to be very satisfactory. The following problems were taken up by members of the staff

"The Structure of Perception in Various Stages of Cultural Development (Perception of Color, Form, and Optical Illusions)" Mr L S Sazaryanz and Mr E N Mordkovich

"The Configuration of Vision in the System of Visual Thinking" Mr A R Luria, Mr L S Sazaryanz, Mr E N Mordkovich and Mr V V Zacharova

"Structure of Elementary Intellectual Processes in Various Stages of Historico psychological Development": Mr A Baiburova and Mr H Hakimov

"Verbal Logical Configurations in the System of Visual Thinking" Mr M Hodzinova

"Concept Formation in Stages of Cultural Development" Mr A D Kolbin

"The Development of Causal Thinking". Mr P I Leventuev

"Traditional Religious Thought in the Development of the Personality" Mr A D Kolbin and Mr H Asharfi

"Perception of Printed Material in a System of Visual Thinking" Mr F N. Shemyakin and Mr P Yussupov

"Numerical Operations in a System of Visual Thinking": Mr A A Usmanov and Mr V. N Arbuzov

"Self-Analysis and Evaluation of Other Individuals at Various Stages of Personality Development" Mr A. R. Luria and Mr. V. V Zacharova.

All these studies will be published in the transactions of the expedition and some subsequently in foreign psychological journals The expedition is an attempt at collective experimental research by a group of psychologists undertaken for investigation of psychological origins in human development. A similar expedition will be organized in the summer of 1932 to continue the same work It will have an international character, as it is planned to invite foreign psychologists to participate in it. All inquiries should be addressed to Professor A R. Luria, Serebryani Pereulok 5, kv 1, Moscow, U S. S. R

SCIENTIFIC NOTES AND NEWS

THE University of Pennsylvania conferred the honorary degree of doctor of science on Dr Edgar Douglas Adrian, of Cambridge University, Foulerton professor of the Royal Society, on October 13

DR. LAURENCE GOULD, geographer and geologist, who was second in command of the Byrd Antarctic expedition, will receive the gold medal of the Geographic Society of Chicago Dr Fay-Cooper Cole, of the University of Chicago, will present the medal at the annual post-vacation luncheon of the society in Chicago on October 31

DR H J GERSTENBERGER, professor of pediatrics in the School of Medicine of Western Reserve University, has been elected to honorary membership in the German Pediatric Society He is the second American to be elected Dr Gerstenberger recently addressed the society at a meeting in Dresden on "A Study of Rickets Disease in the Babies' and Children's Hospital in Cleveland"

THE North Persian Forces Memorial Medal for 1930 has been awarded to Dr T F Anderson, of the Colonial Medical Service of England, for his paper on "A Report on an Investigation of Health Conditions on Farms in the Trans-Nzoia, with Special Reference to Malaria," published in the *Kenya and East African Medical Journal* for January, 1930

DR AGNES BLUM, of the Kaiser Wilhelm Institute for Biology, has been awarded the Leibnitz silver medal by the Prussian Academy of Sciences for her work on alcohol and heredity

DR BURT R SHURLY, of Detroit, has been made president-elect of the American Academy of Ophthalmology and Otolaryngology Dr Samuel Hanford McKee, of Montreal, has been elected president, and Dr Gordon B New, of Rochester, Minnesota, vice-president

DR JAMES RAMSAY HUNT, of New York City, has been made president of the American Psychopathological Association Dr L Eugene Emerson, of Boston, was made secretary

AT the Massachusetts Institute of Technology, Professor Charles F Taylor has been made head of the department of aeronautical engineering, Dr Louis J. Bircher, professor of physical chemistry at Vanderbilt University, is visiting professor of chemistry; Professor W Spannhake, formerly professor at the Technische Hochschule in Karlsruhe, Germany, will conduct courses in hydraulic engineering, Dr Ralph D Bennett, for the past year research associate in cosmic rays at the University of Chicago, has been appointed associate professor of electrical engineering, and Dr Louis B Slichter, of the California Institute of Technology, associate professor of mathematics. The department of physics has added to its staff as assistant professors Dr Philip M Morse, Mr V Guillemin and Dr. W B Nottingham Dr Morse attended the University of Munich last year as international research fellow, while Dr Nottingham was previously engaged in research work at the Bartol Foundation

THE following appointments have been made at Tufts College Mr James R Harrison, assistant professor of physics, Mr Walter Miller, assistant professor of mathematics, Professor Alanson T Warren, formerly of William and Mary College, professor of biology In the medical and dental schools, Dr Sydney C Dalrymple, pathologist at the Newton Hospital, will instruct in pathology, Dr Edward K Ellis has been promoted from assistant professor to full professor in the department of ophthalmology, Dr Allen Greenwood, professor of ophthalmology, has become professor emeritus, and Dr M Garcia Banus has been promoted from assistant to associate professor of physiology

DR GILBERT H AYERS, of the University of Wisconsin, has been appointed assistant professor of chemistry at Smith College Dr Neal H McCoy, National Research Council fellow in mathematics at Princeton University, has been appointed assistant professor of mathematics

DR B F CLARK, of the Massachusetts Institute of Technology, has been added to the faculty of Birmingham-Southern College as assistant professor of chemistry

DR. EDWARD A STRECKER, professor of nervous and mental diseases at Jefferson Medical College, has been appointed professor of psychiatry at the school of medicine of the University of Pennsylvania.

DR GEORGE R HERRMANN, associate professor of medicine in the school of medicine of Tulane University, has been appointed professor of clinical medicine at the school of medicine of the University of Texas

AT the North Carolina College for Women, Greensboro, Dr A F. Thiel, associate plant pathologist of the U. S Department of Agriculture at the University of Nebraska, has been appointed assistant professor of botany, and Mr Charles Crittenden, assistant professor of geography

Dr Herbert Randolph Unsworth, medical director of the De Paul Sanitarium and formerly director of the department of mental hygiene of the Louisiana state board of health, has been appointed assistant professor of neuropsychiatry at the new Louisiana State University Medical Center

A fellowship has been granted to Professor Jenaro Moreno Garcia-Conde, professor of mathematics at the School of Arts and Crafts, School of Military Engineers and at the Military Staff College, Santiago, Chile, by the John Simon Guggenheim Memorial Foundation, to study in the United States

Appointments at the Bartol Research Foundation include as new Bartol Research fellows Dr T J Killian, formerly of the department of electrical engineering of the Massachusetts Institute of Technology, and Dr J C Street, of the Rouss Physical Laboratory of the University of Virginia. Dr K T Bainbridge, formerly National Research Council fellow at the Bartol Laboratory, has been appointed a Bartol Research fellow, and Dr Thomas H Johnson has been promoted to the position of assistant director

Dr Ivan M Johnston, assistant at the Gray Herbarium, Harvard University, has been appointed research associate at the Arnold Arboretum

Dr N O Tribble, of Atlanta, Georgia, and Dr Virgil McDaniel, of Seattle, Washington, have been appointed to fill vacancies in the drug control unit of the U S Federal Food and Drug Administration, caused by the recent resignations of Dr J J Durrett and Dr G E Clarke

The following members of the research staff of the Roessler and Hasslacher Chemical Company, Inc, have been transferred recently from the plant at Perth Amboy, New Jersey, to the plant at Niagara Falls, New York Dr. Sterling Temple, Dr B S Lacy, Dr A M Muckenfuss, Dr J F Reichert, Dr C J Wernlund, Mr A. T Hawkinson, Mr A W Rudel, Mr J M Wainscott and Mr H. A Bond

Mr R D Bean, formerly manager of the engineering development department of the Brown Instrument Company, Philadelphia, has been promoted to chief engineer

Professor Henri Fehr, head of the department of mathematics at the University of Geneva, has been appointed rector of the university

Professor J. C McLennan has retired as professor and director of the physical laboratory at the University of Toronto and will take up his residence in England

Dr W Reid Blair, director of the New York Zoological Park, has returned to New York after spending five weeks in Europe in the interest of the preservation of the European bison He announced that his mission had been successful Within the next year a preserve for the bison, now scattered in the zoos of Europe, will be established in the Vialowsiska Forest, Poland, which formerly was the hunting preserve of the Czars and which since the war had been converted into a national park.

Dr. R S Bassler, of the department of geology, of the U S National Museum, returned on September 18 from six weeks' work in the various European museums and geological field studies in the London and Vienna basins and the Hungarian Plain

Dr J Eastman Sheehan, professor of plastic surgery of the N Y Post-Graduate Medical School, returned on October 7 on the *Olympic* from Paris, where he was attending the International Clinic of Plastic Surgery

Mr Edward H Graham, assistant curator of botany at the Carnegie Museum, Pittsburgh, Pennsylvania, and Mrs Graham have just returned from an extensive four months botanical collecting trip centering in the Uintah Mountains of northeastern Utah A few weeks were spent at Mount Rainier, Washington, with Mr and Mrs Ottmar von Fuehrer, artists and taxidermists from the museum, where material was collected for an alpine plant habitat group to be installed as the fourth of a series of large plant groups now being completed in the museum's hall of botany

Professor William M Davis is giving, in association with Professor Douglas Johnson, two courses on geomorphology at Columbia University this autumn, one a lecture course, the other a seminar During October and November he will also give a course of six or seven lectures at Yale University on the "Origin of the Basin Ranges and on the Coral Reef Problem" At the end of the year he will return to Pasadena for a six months' engagement at the California Institute of Technology

Dr Arthur L Bloomfield, professor of medicine in the Stanford University School of Medicine, gave the opening lecture at the school of medicine of the University of Southern California on September 15

Dr. B. V Christensen, head of the department of pharmacognosy and pharmacology of the college of pharmacy of the University of Florida, has been elected to the post of chairman of the subcommittee on volatile oils of the U. S Pharmacopoeial Revision Committee to succeed Dr. W O Richtmann, of the University of Wisconsin, who was elected last year and who recently resigned The committee consists of fifty members selected from the leading chemists, physicians, pharmacognosists, pharmacologists and pharmacists of the United States

THE department of agricultural chemistry of the University of Wisconsin has been awarded a grant from the American Medical Association for the study of the distribution of phosphorus in rachitic and normal blood This work is to be under the immediate direction of Dr C A Elvehjem.

A GRANT of $600 to Dr G de Takats, of the Northwestern University Medical School, for research work has been made by the committee on research of the American Medical Association.

THE Fourteenth International Physiological Congress will be held at Rome from August 29 to September 3, 1932 The dates have been set at this time to accommodate the American members The congress will be held under the presidency of Professor Filippo Botazzi

THE American Association of Railway Surgeons will hold its next annual meeting in St Louis on November 4, 5 and 6 The Coronado Hotel has been selected as the headquarters Arrangements have been completed for a joint meeting of the Association of Surgeons of the Illinois Central System with the American Association, and the program of the first day will be contributed by the surgeons of the Illinois Central System The committee on arrangements is composed of Drs R A Woolsey, *chairman,* O B Zeinert, Fred W Bailey and R E Owen, of St Louis, and F H. Gunn, of East St Louis Dr G G Dowdall, of Chicago, is president of the American Association of Railway Surgeons, and Dr Louis J Mitchell, of Chicago, is secretary

WE learn from the *Journal* of the American Medical Association that the third International Congress of Radiology was held on September 11 in the Great Hall of the Sorbonne, in the presence of M Camille Blaisot, minister of public health, and under the presidency of Dr Béclère, aided by Madame Curie as honorary president. The addresses read by the delegates of foreign countries took up the first hours Dr. Pfahler, in the name of the American radiologic societies, presented Dr Béclère with an ivory gavel. Thereupon, Professor Forsell, after passing about the neck of the president the gold chain presented by the British Institute of Radiology, delivered an address on "The Crusade against Cancer." In greeting the 1,200 delegates of the forty countries represented at the congress, M Blaisot declared that professional solidarity in the pursuit of scientific knowledge constituted one of the best means of maintaining peace among men. After the session the delegates went to the Elysée, where a reception was held in their honor. Dr Béclère, assisted by the other officers of the society, presented the delegates to M Paul Doumer. Owing to the financial situation, the German physicians were unable to participate in the congress

THE Fifth Spanish Congress of Pediatrics will be held at Granada from October 19 to 23, under the presidency of Professor Suñer Ordoñez.

INDUSTRIAL research problems were discussed at a conference held at Purdue University on October 9 and 10, under the auspices of the Purdue Research Foundation Plans for the gathering were announced by President E C Elliott, of the university Invitations were sent to between 150 and 200 commercial and industrial leaders of Indiana and other Middle Western states to attend the meeting and also to be present at a dinner on the evening of October 9, at which David E Ross, president of the board of trustees of Purdue University and a director of the Research Foundation, was the host Speakers for the gathering included Dr Harrison E. Howe, editor of *Industrial and Engineering Chemistry,* who was the principal speaker on the banquet program Governor Harry G Leslie, President Elliott and Mr. Ross also gave brief talks at the banquet On October 10, John M. Moody, of New York City, well-known economist, who is regarded as a leading authority on financial topics, was the principal speaker. On the program with him was Howard W Blakeslee, science editor of the Associated Press in New York City

A GIFT of $1,000,000 to Atlanta University at Atlanta, Georgia, one of the pioneer institutions of higher learning for Negroes, from an anonymous friend of the university, was announced here yesterday by Dean Sage, president of the board of trustees. The buildings are to cost $625,000, and $40,000 will be expended in renovation. The remainder of the gift, $335,000, will be set aside as a building maintenance fund The new buildings will be erected on a sixty-acre campus adjoining the campuses of the undergraduate colleges affiliated with the university, Morehouse College for men and Spelman College for women. More than 1,000 students enrolled last year in the three institutions. A new library was recently started, its cost of $300,000 provided by a grant from the General Education Board Dr. John Hope is president of the university.

THE municipal council of Brussels, Belgium, has accepted a gift of $1,000,000 by George Eastman, of the Eastman Kodak Company, for construction of a dental clinic.

PLANS for enlarging the present six-story biological and research laboratory at the Willard Parker Hospital of New York were filed by the department of health The improvement will consist of an eight-story addition in East Sixteenth Street, between Avenue C and the East River The annex will increase the hospital's plottage from 82 by 42 feet to 148 by 88 feet and will cost $700,000 The plans also provide for renovating the interior and renewal of equipment.

A LARGE observatory is now being built for the Geophysical Institute of the University of Leipzig The building, which will be surmounted by an eighty-foot tower, is being erected on solid rock in a forest on the Colm at Oschatz, a suburb of Leipzig Nearby, in a small quarry, an "earthquake cellar" will be excavated for the observatory's seismograph, and two further buildings will be erected for the study of terrestrial magnetism The main building will be chiefly devoted to the study of atmospheric electricity All investigations will be carried out along the lines of international geophysical research

ONE half of one gram of radium was delivered from Belgium on September 18 to the cancer division of Bellevue Hospital in New York. The total consignment, valued at $175,000, will be used exclusively in cancer treatments.

DR. HERBERT S DICKEY, explorer and ethnologist, returned recently after five and a half months' absence during which he made his fifth expedition up the Orinoco River and discovered its source, hitherto unvisited by white men Arriving on the Munson liner *Munamar*, he stated that the source of this great river is not in Venezuela, but actually in Brazil, some sixty miles west of the Parima Mountains, the dividing line between the two countries

THE graduate division of the school of geography at Clark University has established headquarters at Wellfleet, Mass, for the fifth annual Clark Field School of Geography under supervision of Dr W Elmer Ekblaw, Dr Wallace W Atwood, Sr, president of the university, and Dr. Wallace W Atwood, Jr. The group will survey the lower arm of the cape and then move the camp either to Brewster or Barnstable. The study is one step in what will eventually be a complete study of Massachusetts During the past four years the Connecticut Valley has been the object of study

WE learn from the *Journal* of the American Medical Association that March 24, 1932, will be the fiftieth anniversary of the discovery by Robert Koch of the tubercle bacillus The federal minister of the interior and the minister of the Prussian department of welfare have taken the initial steps to inaugurate suitable ceremonies in commemoration of the event. From May 17 to May 20, 1932, a commemorative assembly will be held in Berlin On May 18 there will be a special commemorative session, in which German and foreign scientific men will participate, and on May 19 and 20 further scientific sessions will be held. It is planned also to reorganize under the name of the Robert Koch-Gedachtnis-Stiftung the Robert Koch foundation that was disorganized during the inflation period, and, above all, the importance of Koch as a scientist will be brought before the people in a suitable manner Reichspräsident v Hindenburg has consented to serve as the patron of the undertaking, and the imperial chancellor will be the honorary chairman of the committee on arrangements. In addition, a committee to aid in the organization of the scientific assembly will be appointed, to consist of German and foreign scientists and investigators.

THE New Jersey state department of conservation and development has put into operation a new forest nursery to meet increased demands for tree seedlings and to provide better conditions for raising species best suited for planting in South Jersey The nursery, which is located in the Green Bank State Forest, near Green Bank, Burlington County, will have an ultimate capacity of 6,000,000 seedlings.

Two excellent specimens of the Persian wild ass and four of the Persian wild goat have been received at the Field Museum as a result of the recent expedition conducted by James E Baum, Jr In the near future, one or more of the animals will be mounted for exhibition.

DISCUSSION

BILATERAL GYNANDROMORPHISM AND LATERAL HEMIHYPERTROPHY IN BIRDS

BILATERAL gynandromorphism in birds constitutes a well-marked class of abnormalities, cases of which are, however, very rare. There are only ten cases recorded in the literature, more or less completely. In five of these cases there is agreement between external and internal sex characters of the same side of the body; the right side of the body possesses a testis internally and male plumage externally, while ovary or ovotestis (one case) and female plumage appear on the left side. These are the cases of Lorenz[1] (*Pyrrhula*), of Weber[2] (*Fringilla*), of Heinroth and Poll[3, 4] (*Pyrrhula*), of Tikhomoroff[5] (*Pyrrhula*) and of Ogneff and Ogneff[6] (*Pyrrhula*) The apparently clean-cut situation presented by these cases has aroused great interest on account of its resemblance to the well-known bilateral gynandromorphs of insects This resemblance naturally suggests an explanation similar to that demonstrated for the gynandromorphs of *Drosophila, i e,* somatic disjunction of sex-chromosomes Such an explanation is, however, in conflict with an equally well-established principle of a physiological order, *viz*, that the sex-characters of the plumage of birds are controlled by the female hormone which circulates in the blood, hence equally to the two sides of the body

---

[1] Th. Lorenz, *Bull.* de la Soc. des Nat., Moscow, n. s. 8, 325 (see p. 333), 1894

It is because the even distribution of the female sex hormone *seems* to exclude an explanation of bipartite distribution of sex-characters of plumage on a hormonal basis alone that the theory of somatic disjunction of sex-chromosomes is still appealed to as part at least of the explanation of this phenomenon I shall, however, attempt to show that the principle of threshold of hormone action, as demonstrated for plumage characters by Juhn, Faulkner and Gustavson[7] and by Lillie and Juhn (in press) furnishes a complete explanation of the bipartite plumage characters in the five cases already cited, as well as in the other cases, the other abnormalities of all the cases also fall into well-known physiological categories

We may first note that the theory of somatic disjunction of sex-chromosomes is of very doubtful validity as applied to this problem, even though advocated by Bond[8] and Goldschmidt,[9] and favored by Macklin[10] and Zawadowsky[11] This is for the reason that it has been demonstrated on a large scale by experiments on fowls both by surgical methods (see especially Domm[12]), and by injection of chemically prepared sex hormones (Juhn and Gustavson,[13] Juhn, Faulkner and Gustavson,[7] and Lillie and Juhn (in press)) that the sex of the soma makes no difference in the reaction of feather germs to the sex hormones. So far as sex-characters of plumage are concerned the male hormone is without any action, and the female hormone impresses the female characters on all feather germs of tracts exhibiting sex dimorphism, whether on a male or a female bird The same would certainly be true, if one side of a single individual were male in its sex chromosome composition and the other side female Somatic disjunction of sex chromosomes, even if granted, would therefore not help in explaining the phenomenon, unless it were shown that a different threshold of reaction exists for genetically male and genetically female feather germs This assumption has no experimental support So far as our experiments go, though not directed specifically to this exact point, no difference of threshold has been suspected between corresponding feather tracts in males and females

The difficulty in the theory of somatic disjunction of sex chromosomes as applied to the problem in question does not, moreover, stop here In the case of Bond's pheasant, for instance, not only was there a sex difference in the plumage of the two sides of the body, but the outer half of each tail feather was male and the inner half female *on both sides of the body* We would therefore have to assume a second somatic disjunction for half of the germ of each tail feather on the male side of the body, and on the female side to provide for reacquisition of a lost chromosome in exactly half of each feather germ involved That the plumage characters on the two sides of the body are not purely male or female in gynandromorph birds has also been noted by Lorenz[1] and Neunzig[14]

Leaving aside therefore the sex chromosome mechanism, let us see how the matter can be explained on a purely physiological basis We shall confine ourselves at first to plumage characters The female hormone is the differentiating factor The principle established by Juhn and Gustavson[13] and farther elaborated by Juhn, Faulkner and Gustavson[7] in my laboratory, *viz*, that the threshold of reaction of feather germs to the female hormone is a direct function of their growth rate furnishes the basis of the explanation By virtue of this principle they were able to produce from capons, at a given dosage of female hormone, birds in which the slowly growing saddle feathers, for instance, changed during regeneration to female, while the more rapidly growing breast feathers remained male These are thus "transverse gynandromorphs" in plumage characters in the usual sense, but produced by a *difference of* hormone threshold in different feather tracts

Now it must be noted here that, when a normal concentration of female hormone is present in the blood, all dimorphic feather tracts produce female feathers, this is the normal female condition. Gynandromorph conditions in the plumage, therefore, are dependent on a subnormal amount of female hormone, which can be regulated by dosage in castrates, as in the above experiments, or by ovarian deficiency, as in partially ovariotomized birds.

---

[2] Max Weber, *Zool Anz*, 13, 508, 1890, Cabanis, *Journ f Ornithol*, p 344 (cited from Weber), 1874

[3] O Heinroth, Sitz ber Ges naturf Freunde zu Berlin, p 328, 1909

[4] H Poll, *ibid*, p 331, 1909

[5] A Tikhomorow, *Rev Zool Russe*, 2, 196, 1918

[6] Ogneff and S Ogneff, *Rev Zool Russe*, 4, 259, 1924

[7] Mary Juhn, G H Faulkner and R G Gustavson, *Journ Exp Zool*, 58, 69, 1931

[8] C J Bond, *Journ of Genet*, 3, 205, 1913

[9] R Goldschmidt, "Die sexuellen Zwischenstufen," Julius Springer, Berlin, 1931 See p 479

[10] M T Macklin, *Journ Exp Zool*, 38, 355, 1923

[11] M M. Zawadowsky, *Arch f Entw Mech*, 108, 563, 1926

[12] L. V Domm, *Journ Exp Zool*, 48, 31, 1927

[13] Mary Juhn and R. G. Gustavson, *Journ Exp Zool*, 56, 31, 1930

[14] R Neunzig, "Die gefiederte Welt," 53, 93, 1924.

It is known that a testis usually develops on the right side of ovariotomized birds, owing to compensatory hypertrophy of the rudimentary right gonad (Domm[12] and Appel[15] and others) The existence of a testis on the right side and ovary on the left is presumptive evidence of ovarian deficiency in birds, and it is to be noted that the ovary is small in the case of gynandromorph birds, and generally immature, though it is difficult to be certain to what extent this may be due to seasonal conditions. In Bond's case there was an ovotestis on the left side and no gonad on the right, so that there is a lack of correspondence of internal and external gynandromorphism

The presumption is therefore strongly in favor of a condition of ovarian deficiency in all cases, seven in number, in which the condition of the reproductive organs is reported. We have, therefore, in these birds conditions favorable for the occurrence of gynandromorph conditions in the plumage The problem to be solved is its bilateral distribution, whether in the plumage as a whole, or in individual feathers as in Bond's case

If the cases in the literature be examined again, a very striking fact comes to light, which has not hitherto been emphasized, *viz*, that the side on which the male plumage appears is hypertrophied as compared with the opposite side in the four cases in which data exist. Thus in Poll's case the author notes incidentally that the right wing is much larger than the left, the photograph, moreover, gives the impression that the right tarsus is also longer and heavier than the left. In Ogneff and Ogneff's case the right wing is similarly reported to be somewhat longer than the left. In Neunzig's case, also of *Pyrrhula*, it is the left side that exhibits the male plumage, the right side being predominantly female. Although the author fails to mention asymmetry, yet his figure of the bird shows the left foot very much larger than the right In Bond's case the left tarsus and phalanges are larger than the right, and there are other evidences of hypertrophy of the left side, which is the male side in this case. The hypertrophy occurs on opposite sides in these cases, two on the right and two on the left, and *the male plumage is on the hypertrophied side in each case.* Macklin's case was an extreme example of hemihypertrophy (right), but unfortunately the fowl was plucked before it was received for study, so that the plumage characters were known by report only and very incompletely In the other cases, six in number, no observations were recorded on symmetry or asymmetry

Congenital hemihypertrophy in man is well known clinically, though it is a rather rare condition Gesell[16] made a particularly careful study of the condition Stanton and Tuft[17] state that 41 cases were on record at that time, more cases have been recorded since The right side is more often affected than the left, but the condition may occur on either side, it occurs in both males and females Besides the differences in size on the two sides of the body, which are often extreme, the hypertrophied side, according to these authors, may exhibit excessive sebaceous and sweat secretion, thicker growth of hair, more rapid growth of nails, higher temperature by a degree or two, and earlier eruption of teeth

The hypertrophied side has a higher growth rate than the normal side in the clinical cases, evidenced not only by the larger size of all parts, but also by the more rapid growth of continuously growing structures on this side, such as nails and hairs

In a paper by Lillie and Juhn now ready for press it is shown that the patterns of individual feathers are largely dependent on a differential growth rate along the axes of the barbs Moreover, in highly asymmetrical feathers, in which the level of growth rate of all the barbs of one side of the feather is higher than on the other, it is possible to produce bilateral gynandromorphism by injections of female hormone regulated so that its concentration is above the threshold of reaction on the less rapidly growing side and below it on the other

Therefore, in cases of pronounced hemihypertrophy in birds, in which ovarian deficiency exists, we would expect that the plumage of the more rapidly growing (hypertrophied) side would be male, if the threshold corresponding to its growth rate were above the existing hormone concentration, while that of the opposite side might be female corresponding to a slower growth rate. The degree to which this condition would be expressed would depend on the time of origin of the ovarian deficiency and its duration and extent in relation to moulting periods. The condition need not be pure with reference to the two sides; this would be a matter of fluctuating concentration of the female hormone; and it is noticeable that in the case of Bond's pheasant, Neunzig's bulfinch and some other cases, it is far from being so, which constitutes another difficulty for the theory of somatic disjunction of chromosomes Moreover, the same condition would account for the bilateral gynandromorphism of individual feathers

---

[15] F. W. Appel, *Journ. Exp. Zool.*, 53, 77, 1929.

[16] Arnold Gesell, *Arch of Neur and Psych.*, 6, 400, 1921.

[17] James Stanton and Louis Tuft, *Journ.* Am. Med. Ass., 90, 1,422, 1928.

These principles fit the situation so perfectly in all respect that I have no hesitation in presenting the theory that these gynandromorph birds are cases of hemihypertrophy combined with ovarian deficiency, as by far the most reasonable interpretation The theory has the very great advantages of requiring no subsidiary hypotheses and of being in accord with well-known physiological principles

If such lateral hemihypertrophy were to occur in a male bird, gynandromorph characters would not appear, for no ovarian tissue occurs in males Crew's[18] case of lateral asymmetry in a male resulting from a cross between Light Sussex ♀ and a Rhode Island Red ♂ is a case in point The bird was male externally and internally, the left side was much hypertrophied, especially in the skeleton, with the exception of the skull and vertebral column which were practically symmetrical The left leg was pinky white, somewhat like the color in the Light Sussex, and the right leg yellow like the Rhode Island Red This difference suggested the theory that an autosome carrying the dominant factor for white epidermal pigment had been eliminated during early cleavage divisions of a male zygote heterozygous for white and yellow, though it is somewhat difficult to correlate this with the general hypertrophy of the left side, as Crew admits If, on the other hand, we assume that the lateral hemihypertrophy is the primary factor in this case, the other asymmetrical features might conceivably receive a consistent physiological explanation

The data suggest that it would be profitable to look for cases of lateral hemihypertrophy in birds, with a view to ascertaining how common the phenomenon is, and what other asymmetrical characters may be associated with it It would be particularly desirable to ascertain if in the female it is always associated with gonadal abnormalities, or whether the fact that it is so far known in females only in such association, is due to the interest that has attached to gynandromorphism and the lack of interest in asymmetry as such.

The interpretation of hemihypertrophy itself has been dealt with by Gesell[16] and by Newman [19] Gesell is inclined to interpret it as incipient twinning, thus explaining the degree of physiological isolation that seems to exist in such cases To the writer these cases seem to be classifiable as extremes of the asymmetry that characterizes bilaterality in all organisms or parts of organisms It may be, of course, that exaggeration of asymmetry of the germ in early stages is one of the causes that leads to twinning, a suggestion that would reconcile these two points of view In the feather system of birds there are all possible degrees of asymmetry of individual feathers ranging from the barely perceptible to the most extreme types, and these gradations have certain regular relations to position on the body

Without discussing the question farther in this place we may conclude at once by saying that the problem is much more surely one of the physiology of bilateral asymmetry than of differences of genetic constitution on the two sides of the body

FRANK R LILLIE

UNIVERSITY OF CHICAGO

ANGUILLULA ACETI—A DESIRABLE NEMA FOR TYPE STUDY

DR. N A COBB's excellent summary of recent advances in nematology, in these pages, prompts the writer to give his own experience in teaching the subject Early attempts with mixed classes of students forcefully demonstrated the impracticability of using such forms as *Ascaris* and *Gigantorhynchus* Considerable friction invariably resulted, some students positively refusing to dissect these forms and even dropping the course To eliminate this friction, search was made for other forms, the little vinegar eel, *Anguillula aceti*, being finally selected for type study This nema yielded such satisfactory results that it was subsequently adopted by the writer for use in his general biology, zoology and parasitology classes

The following reasons induced the above selection of *A aceti*

(1) It arouses real interest in and elicits favorable comments from the students.

(2) It may be procured at any time of the year from a corner grocery by asking for bulk cider vinegar.

(3) It will live indefinitely in the laboratory if transferred to fresh vinegar every two weeks.

(4) It is a simple nematode with a simple life history The entire life history can be worked out in a single two-hour exercise

(5) Being viviparous and transparent, all stages of development may be examined *in utero*.

(6) Anatomical details, such as alimentary tract, nerve ring, spicules and sperms of male, uterus and uterine development in female and all young and intermediate stages can be worked out with a 4 mm objective.

(7) Very spectacular effects can be produced by

---

[18] F A E Crew, *Journ. of Genetics*, 20, 179, 1928.

[19] H H Newman, "The Physiology of Twinning." 230 pp University of Chicago Press. 1923

placing living nemas in a well slide and projecting on a daylight screen with a microprojector Under suitable magnifications many of the anatomical features may be shown on the screen in this way

Individual studies were carried out from living and preserved material This last was prepared by the writer in the following way With a pipette, the vinegar eels were collected into a graduate until 50 ml of solution was obtained This was then poured into an Erlenmyer flask containing 10 ml formalin and quickly heated over a Bunsen burner The heat promptly kills and straightens the nemas and after about a minute they are removed from the flame and allowed to stand in the formalin for one hour Subsequently they were filtered through a piece of silk cloth, placed in 50 per cent. alcohol for one hour and in 70 per cent. alcohol, to which last some Delafield's hematoxylin stain was added (5 ml of the stain to 50 ml of the alcohol) In this they may be kept indefinitely For use a drop of the solution was given to each student on a slide In such material all the forms indicated in the above outline could be found by every student The nemas show no distortion, and all of the structures stand out clearly If desired, this material may be further dehydrated and mounted in balsam, although the optical effects in this last medium are not as satisfactory as when examined in alcohol

George Zebrowski

Buck Creek, Indiana

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SOME LABORATORY USES FOR CROWN SEALED MILK BOTTLES[1]

The Crown Seal used for milk bottles is a metal cap similar to those used for beverage bottles, except that the milk bottle cap is larger The cap is crimped tightly over the neck of the bottle and, with a suitable lining, is air tight

In most bacteriological laboratories the storage of media is a problem It is customary to sterilize media in large flasks plugged with cotton and to store these in the refrigerator The flasks are relatively expensive and easily broken To avoid boiling over of the media during sterilization and wetting of the cotton plugs the flasks may be filled only about two thirds full They require a great deal of refrigerator space Through the cotton plugs the media evaporate and are exposed to oxidation by atmospheric oxygen In time molds may grow down through the cotton plugs The use of milk bottles with cork-lined Crown Seals (Fig 1) eliminates these difficulties The bottles may be filled with media to within about two inches of the top. The caps are firmly crimped on by means of a suitable capping machine (Fig 2) before the bottles are placed in the autoclave. During autoclaving the pressure outside should equalize that within the bottles and there is no leakage or boiling over if ordinary care is used in allowing the steam pressure to drop slowly at the end of the autoclaving period.

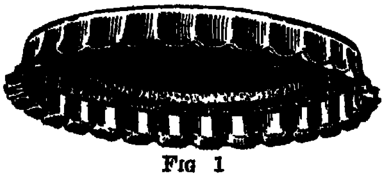


Fig 1

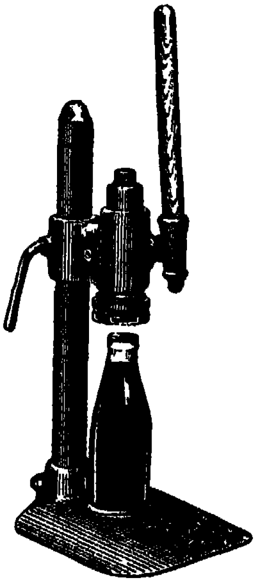


Fig 2

The bottles of sterile media may be stored at room temperature in any convenient place. They require relatively little shelf room There is no evaporation There is little opportunity for oxidation since the air is excluded except for the small amount remaining over the media when the bottles are sealed The bottles of media may be handled and shipped with no danger of leakage or contamination and little danger of breakage. The quality of glass obtainable in the milk bottles is fair We have noted little chemical action on the glass Occasionally a bottle may break under the influence of heat in the autoclave, especially if the bottles have been filled with cold media. Efforts are being made to procure Pyrex bottles for this purpose. The cost of the milk bottles is very low as compared with that of laboratory glassware.

---

[1] From the Department of Pathology and Bacteriology, Johns Hopkins University, Baltimore, Md

The metal caps cost a fraction of a cent each. The cost of the sturdy capping machine shown in Fig 2 is about $35 00 and a cheaper one is procurable The quart bottle seems to be the best size It fits into the autoclave, allows ready penetration of heat and stores conveniently on shelves There is no disadvantage in having to distribute a large lot of medium into a number of bottles The large mouth milk bottle is more convenient to fill and to pour from (especially for agar) than the small mouth beverage bottle

In 1925 I reported on "The Preservation of Bacteria in Vacuo."[2] Dried on small bits of filter paper in a vacuum bottle most bacteria remain viable without transplanting for many years The dried cultures were enclosed in pint milk bottles, the mouths of which were ground down flat against small glass plates and these were sealed with a wax mixture. The labor and difficulty of grinding down the bottles against the glass plates has doubtless discouraged the more general use of this method of preserving cultures. We now find that a smaller milk bottle (one half pint) with a metal Crown Seal which has a special rubber composition ring lining makes a much more convenient and readily available vacuum bottle at small cost The cultures, smeared on small bits of sterile filter paper in small cotton-plugged vials, are placed over some dehydrating agent (calcium chloride has been used) in the bottle. The edge of the bottle is rimmed with vaseline to make a more perfect contact with the rubber ring in the cap. The cap is placed lightly over the bottle (not crimped) and the bottle is placed under the bell jar of a vacuum pump When a vacuum has been established within the bell jar the air is admitted suddenly The inrush of air into the bell jar closes the bottle immediately without entering the bottle To insure a permanent seal the bottle is then placed under the capping machine and the cap securely fastened into place After using these bottles for several months we have noted no leakage as indicated by small manometers placed within the bottles.

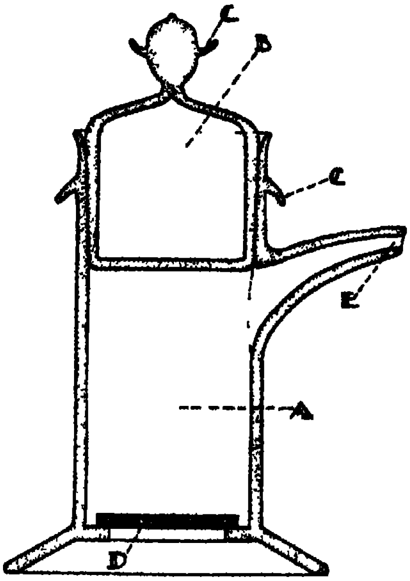
Quart milk bottles serve very well for the cultivation of anaerobic bacteria in test tubes. Pyrogallol and a strong solution of sodium carbonate are placed in the bottle along with the culture tubes and the bottle is promptly and securely sealed with one of the rubber composition lined caps

J Howard Brown

A DILATOMETER FOR MEASURING THE SWELLING OF SEEDS

The dilatometer here described—for measuring the rate and amount of swelling when immersed in an aqueous solution of seeds, dried fruits or other objects composed of or containing water-imbibing colloidal materials—is of the type in which the increase in volume of the test object is evidenced by the displacement of shot or sand surrounding it The distinctive feature of the instrument is the avoidance of the use of metal in contact with the solution in which the test object is immersed, and is made possible by the utilization for the purpose in hand of two products of the glass industry which have recently appeared on the market

(1) For the bottom wall of the dilatometer chamber, which is perforated to permit the flow of water through it, the perforations being too small to allow the escape of any of the enclosed shot or sand, use is made of a fritted glass filter disc manufactured by Schott and Gen, of Jena, Germany In addition to avoiding the use of metal, this has the additional advantage of being more rigid than wire cloth



(2) For the shot or sand surrounding the test object in the dilatometer chamber use is made of glass beads of very small sizes which are manufactured in Czechoslovakia and in Italy and which are employed in this country in the manufacture of decorative furniture novelties to produce a "crystal frosting" effect on fabric and paper surfaces. These glass beads are obtainable in sizes as small as 0.25 mm diameter, and in bright colors as well as in untinted glass. They are perfect spherules and roll and glide easily over one another when wet as well as when dry; they are greatly superior in this respect to the best grades of silica sand commercially obtainable. As compared with lead or steel shot these glass beads have the

---

[2] Abstracts of Bacteriology, ix: 1, p. 8, January, 1925.

obvious advantage of being of much lower specific gravity, in addition to being of a non-metallic material.

In the accompanying line cut, illustrating the instrument in vertical section, "D" indicates the fritted glass filter disc cemented into the bottom wall of the chamber "A." A wide opening is provided at the top of the chamber for insertion of the test object (not shown) and filling with the glass beads (also not shown). After having been thus filled, the dilatometer chamber is closed by the hollow ground glass stopper "B" which is held in place, against the pressure developed in the chamber, by strong rubber bands wound around the projecting hooks "C" on the stopper and on the outside chamber wall. The dilatometer is then immersed in the solution the swelling effect of which on the test object is to be determined, above the level of the orifice "E" but below that of the hooks "C" on the outside chamber wall, to avoid immersion of the rubber bands in the solution. As the test object in the dilatometer chamber swells, glass beads are extruded from the chamber through the orifice "E"—the number or volume of the beads extruded serving as an indication of the increase in size of the test object in the chamber.

It should be noted here that the volume occupied by a quantity of shot, sand or glass beads is not constant, but will vary somewhat with the packing of the particles.[1]

M. A. RAINES

DEPARTMENT OF BOTANY,
HOWARD UNIVERSITY

SPECIAL ARTICLES

LAND TYPES OF THE TRINITY BEDS

THE Trinity beds are a conspicuous feature in the geology of the state of Texas. There they extend as a broad belt thirty or so miles wide for a distance of 300 miles from the Red River valley across Wise, Palopinto, Erath, Comanche and other counties, south-southwesterly to Fredericksburg (seventy miles due west of Austin). Along its eastern edge the Trinity overlaps the Pennsylvanian, and then south and west the beds run under several later horizons. The series consists in flotation sands, finer conglomerates and thin shelly, limy layers of fresh to brackish and fluvial marine origin, in all 500 feet thick. The invertebrates found in abundance at many points in thin interfingerings of limy rock are fairly well known. Also, R. T. Hill early used for the Trinity series the very good common name of "dinosaur beds" as further noted for their petrified forests, and somewhat later for three isolated and rare petrified cycads.

Occasional finds of land forms in the Trinity long gave little indication of wealth or variety of type, but other and fine discoveries have been accumulating for several years. Through the interest of Mr. Jene W. Wagner, of Burkburnett, Texas, and Mr. Bart Johnson, of Comanche, a splendid cycadeoid trunk from just east of the latter town was some years ago presented to the U. S. National Museum. This specimen I have sawn and studied in detail. Later, another handsome specimen from the neighborhood of Fredericksburg was turned over to Dr. Sellards, of the Texas survey; and I have since cut this stem, which bears young fronds. While, on visiting the general locality with Professor Plummer, of the University of Texas, early this year, we collected additional specimens as associated with the conifers. Again, Mr. Ross R. Wolfe, of Stephenville (Erath County), through persistent inquiry and effort has assembled a varied and most important series of the cycadeoid stems from the Stephenville country. Of these he has donated representative forms to Yale.

During a visit to Stephenville last March and April, aided by Mr. Wolfe and other friends, I was enabled to see why the land types of the Trinity beds and the general facts relating to them have appeared to view rather slowly. In that grassed and forested country fossil hunting is not easy. But the cycads can be found, and it is not too much to say that, considering their wide extent, the Trinity beds must be ranked as one of the five great cycad-yielding terranes of North America—the other four being the Arundel of Maryland, the Lakota of the Black Hills region, the Como of the Black and Freeze Out Hills, and the Mesaverde of the Chuska Mountain region of New Mexico and Arizona.

On inquiry, it was learned that some ten miles from Stephenville along the Paluxy River various portions of a reptilian had been noted. A visit to the locality resulted in the assemblage of a large part of the skeleton of a dinosaurian standing about six feet high at the hips, and thus one of the few lower Cretaceous dinosaurs from North America. Accurate determination of the form and species is greatly to be desired. It was found, too, that the general locality yields small Testudinates. In addition, large serial three-toed dinosaur tracks were pointed out as they occurred. A single track of yet larger form had been found; and cutting across a stream bed three miles from Glen Rose, another and splendid bipedal series of lesser three-toed tracks was seen. These latter tracks could have pertained to the skeletal type of the Paluxy.

[1] Smith, Foote and Busang, *Physical Review*, 34: 1271–1274, 1929.

Regarding the associated conifer forests it may be added that the amount of petrified wood is enormous. The conservation is not favorable to study, but the general types can no doubt be determined with sufficient accuracy The trees are seldom large, not much if at all exceeding two feet in diameter The wood has been much gathered for more or less ornamental use in rock gardens at various points about the country of the Trinity terranes Especially at Glen Rose and in several other villages a type of fossil bungalow (!) may be seen, in which the short lengths of petrified wood are freely used to face cement construction The result is really ornate Inside, the fireplace may also be built of the wood (!), which is sold in quantity at a low price for such building The wood is thus definitely a commodity, the use of which might well be encouraged, so long as it does not go to the extreme of putting specimens of direct value to science into inappropriate places

Five species of silicified cycadeoids are recognizable in the general series from the Trinity beds, which has finally reached importance, and should have further or preliminary mention now The types and their localities may be listed as follows

(1) *Cycadeoidea Boeseana* (Wieland, 1921) This type was found in the basal Trinity beds near Bridgeport, Wise County, by Dr Emilio Boese in July, 1915, being the first petrified cycadeoid ever reported from this horizon in the state of Texas, although the *Cycadeoidea munita* (Cragin, 1889) from near Sharon in southern Kansas must come from beds of about the same age The Boese type because of isolation and lack of fruits or leaves could only be named arbitrarily Taken as a young stem it differs little from either the Arundel or the Lakota forms

(2) *Cycadeoidea Barti* A fine new type, the tallest yet found in the Trinity, from about one half mile east of Comanche, and named after Mr Bart Johnson of that town, who donated it to the U S National Museum The second specimen reported from the Trinity The trunk has been freely cut and bears various young cones with elongate receptacular cushions As more fully described (in MS) it appears in all its features to be very nearly related to several of the Black Hills types of the Lakota This seems to be the type mainly occurring about Fredericksburg A University of Texas trunk from there, which I have also cut, bears a few young fronds and is considered the same

(3) *Cycadeoidea Wolfei.* A columnar type with scant ramentum and rather characteristic leaf base spirals, occurring about Stephenville Again, resemblance to Black Hills types (*C Stilwelli*) is seen The species appears validly new as several examples have been secured by Mr Wolfe, one of which he has kindly turned over to the Yale Collections It is justly named for him.

(4) *Cycadeoidea Dyeri* Slender, characteristically branched stems with drooping and much excised frond bases. An uncommonly handsome new species because of a habitus exactly intermediate between the robustly branched cycadeoids of the Lakota, and Williamsonia. The specimen selected as the type bifurcates near the base, and the longer axis then gives off two lesser branches, the height being 30 centimeters with a diameter above the basal branch of 11 centimeters From near Tolar, Texas, and about Stephenville Named for Miss Mamie Dyer of Tolar

(5) *Cycadeoidea Johnstoni* A nearly globular type, usually compressed during fossilization Trunks complete, of large size, up to a foot and a half diameter, with nearly mature seed cones, and crowns of fronds up to 30 in number and forming a ring of large diameter about the crown of very numerous scale (?) leaves Pinnules of the fronds as many as fifty in the lateral row (100 in all) Apparently never branched Occurrence about Stephenville, but appears to recur in the Black Hills, since the seed cones are the same as those figured as *Cycadeoidea* sp on Plate XXXII of my American Fossil Cycads, Vol I The present new type reopens the earlier question as to identity

Many facts could be recited about the landscapes and types of the Trinity The *Cycadeoidea Dyeri* is a new species of note Originally the type was found a few miles out from Tolar, Hood County, Texas, and then later solidly set in mortar along with other fossils on the wall at the entrance of the post office there But on the occasion of my visit, the amiable postmistress, Miss Mamie Dyer, concurred in the view that such a stem was of value to science Only on removal from the wall did its fuller interest become apparent And then Miss Dyer presented the fine specimen for the collection of cycads at Yale It is well named for her Other examples varying somewhat in form but with the branching feature always distinct occur, and, accompanied by Mrs S. F. Davis (wife of Professor Davis, of the John Tarleton College), I had the fortune to find a second stem on the Harris farm near Stephenville A terminal bud of a much larger and heavier cycad also found associated by Mrs Davis belongs to the species *Cycadeoidea Johnstoni*

Cycadeoidea Johnstoni is the best represented species of the Trinity beds as collections now stand, named after General Albert Sidney Johnston, the heroic figure of Shiloh Celebrated in the annals of the Southwest of ninety years ago, a lover of nature and deeply interested in the physical sciences, he led an unresting life, he knew the petrified forests, and he carried often his treasured copy of Sir Charles Lyell in his saddle pockets. The type locality is on the Stone farm, ten miles from Stephenville, about the side of a low, flatly conical hilltop where beside fragments at least three large and complete specimens have been recovered. Considerable petrified wood, mostly fragmentary, is also present. During a visit made with Mr. Wolfe and a large party late in March last, further armor fragments of the cycads were found. The conditions indicate that the general specimen level is undisturbed for some distance along the slope, and that more good material must be present. The exact position of this level measured in feet above the more basal of the "pack sands" can not long remain in doubt if this noteworthy cycadeoid locality, the finest so far known in the Trinity beds, is marked with care. A simple, tasteful, appropriately inscribed monument should here be set up. It would be doubly commemorative of discovery and distribution in the case of such a splendid fossil type, as again seen with such a near certainty in the Black Hills 900 miles north.

Taking the foregoing species and collections from the Trinity beds in fuller view, a group resemblance to the cycadeoids of the lower Lakota is at once discerned. The parallel extends to both simple stemmed and branched species—is, in fact, so close as to become outstanding for all North America. Whatever similarity the Maryland types may have is less evident, as little is known of their fruiting, and branching does not occur. So far as inference may rest on the cycadeoids, by now a most imposing group, the lower Greensand of the Isle of Wight, the lower portion at least of the Lakota carrying the great group of specimens at the Cycad National Monument in the southern Black Hills, and the Trinity beds, are all of quite the same age. It may still be asked whether the Arundel is recent as the Trinity, or old as the Como taken as the equivalent of the Wealden. The Trinity was a flat, subsident, river and bayou, cycad-dinosaur-conifer, forest land, swept by the shallow edges of the sea.

Most of the Trinity cycadeoids are not nearly so well petrified as the Lakota and Como specimens. Finer details of structure are seldom clear. Yet the series as a whole has the finest beauty and value, and often affords singularly handsome polished surfaces. The *Cycadeoidea Barti*, as found at Comanche and at Fredericksburg, has an appearance suggesting original calcification in whole or in part, with subsequent siliceous replacement.

G. R. WIELAND

CARNEGIE INSTITUTION,
YALE UNIVERSITY

EFFECT OF H-ION CONCENTRATION ON THE DIVISION RATE OF PARAMECIUM AURELIA

EXPERIMENTS on the effect of hydrogen-ion concentration on the division rate of *Paramecium aurelia* have been performed, feeding the animals on a pure line of bacteria instead of the "mixed culture" of bacteria heretofore used in such experiments. The *Paramecium* used were from Professor Woodruff's pedigreed strain. The bacterium used was a strain of *Erythrobacillus prodigiosis* which has been kept for several years in the Department of Bacteriology of Yale University. The medium consisted of 1.493 gm. of powdered, desiccated lettuce leaves in 1.0 liter of distilled water. To this was added in the first group of experiments KH_2PO_4 buffer salt to form a M/600 solution. In the second group M/300 buffer was used. The animals were kept in isolation in depression slides, and changed daily under sterile conditions. No bacterial contamination was observed at the end of the experiments, but a very few yeast cells were observed at the end of one experiment. The temperature was controlled by a thermostat.

The lines were carried for ten days each at several different H-ion concentrations, produced by titrating with HCl or NaOH, with the following results:

GROUP 1. M/600 KH_2PO_4. Temperature 28° ± 0.5° C.

pH	No. of lines	Average division rate per 10 days
5.9	6	21.7
6.9	6	18.8
7.2	6	20.0

GROUP 2. M/300 KH_2PO_4. Temperature 26.5° ± 0.8° C.

pH	No. of lines	Average division rate per 10 days
7.0	6	14.0
7.7	6	14.0

It will be seen from the above that the division rate is practically unaffected by change in pH between the limits of pH 5.9 and 7.7. This is in striking contradiction to the very thorough work of Darby ('29),[1] who found a very marked variation in division rate with pH, using the same strain of *Paramecium aurelia*. The author believes that the discrepancy in results lies in the fact that Darby used a mixed strain of bacteria as food for the *Paramecium* as opposed to the pure line of bacteria used in the present work. It has been shown Hargitt and Fray ('17)[2] that over 30 species of bacteria may be represented in ordinary hay infusion. It has also been shown that these species differ greatly in their value as food for *Protozoa* (Hargitt and Fray,[2] Phillips,[3] etc.). It is well established that many of the common bacteria are stenionic and are greatly influenced in their growth rate by changes in pH Therefore it is logical to assume that the ecological balance among the bacteria will be greatly altered by changes of pH, and that where a large number of bacterial species are living together, as in a hay infusion, different species will predominate at different H-ion concentrations

---

[1] H. H. Darby, *Arch. f. Protistenk.*, 65: 1, 1929.

[2] G. T. Hargitt and W. W. Fray, *Journ. Exp. Zool.*, 22: 421, 1917.

[3] R. L. Phillips, *Journ. Exp. Zool.*, 36: 135, 1922.

From the above it is concluded that the difference in division rate of *Paramecium* at different H-ion concentrations, between the limits of pH 5 9 and 7 7, at least, is due to a qualitative change in available bacterial food, and not to direct action of the pH on the Protozoa

Further work is being carried on to determine the behavior of *Paramecium* in a pure culture of bacteria at higher and lower H-ion concentrations than those used in the present experiments

AUSTIN PHELPS
OSBORN ZOOLOGICAL LABORATORY,
YALE UNIVERSITY

INDUCED AUTOTOMY IN THYONE

THE holothurian, *Thyone briareus,* has long been known to exhibit unusual autotomy During this process it casts off the extreme anterior end including the ring of tentacles, calcareous lantern, water vascular ring, nerve ring and throws out with these organs the oesophagus, stomach and intestine

A S Pearse,[1] by injecting strychnine into the body cavity of 20 Thyone, produced such evisceration in seven individuals. J W Scott,[2] induced autotomy in 40 out of 65 individuals by "allowing Thyone to stand in stagnant water until the water became foul" and then following with a "treatment with running water Alternating these processes produced as high as 65 per cent self-mutilated individuals."

During this summer's work at Woods Hole I have found that ammonia water will invariably bring about evisceration Seven N ammonium hydroxide was used in the proportion of one part ammonia to 800 parts of sea water

When the animal is placed in this solution there is usually a brief period of muscle relaxation and an expulsion from the cloaca of the water which filled the respiratory trees Within 15 seconds the longitudinal and circular body muscles contract strongly, reducing the animal to minimum size A few seconds of such contraction is followed by a gradual elongation of the anterior end of the body into which lantern, stomach, intestines and the fluid content of the body cavity are forced As the pressure increases, the body wall about ½ of an inch behind the tentacle ring becomes greatly distended There are no strong circular muscles in this region. The body wall tissue in the distended region thins out and soon bursts allowing the body fluid to gush out carrying along with it part of the viscera. At this point in the procedure the Thyone is transferred to fresh sea water. Most of the viscera are tangled around the lantern, which is partly covered over with the small portion of the body wall anterior to the break. The strong circular muscles just posterior to the break contract so as to close tightly the body cavity at the anterior end The whole procedure to this point occupies about 30 seconds. The original break in the tissue becomes gradually more extensive until within several hours the eviscerated parts are free from the body

The hydroxides and carbonates of sodium and potassium have been used with some success Electrical stimulation applied to the muscles of the body wall will also produce autotomy.

One hundred and fifty Thyone were eviscerated by the ammonia water method Of this number five Thyone did not live In each of these cases the body wall broke at places other than at the customary anterior point One hundred and forty-five Thyone lived until they were killed for the study of the regenerated organs

Under the conditions outlined, autotomy is regular and uniform in occurrence In 96 per cent of the possible cases it was favorable for continued life and the regeneration of lost parts A study is being made of the regenerated tissues.

FRANK R. KILLE
MARINE BIOLOGICAL LABORATORY

BOOKS RECEIVED

CARNEGIE MUSEUM *Annals* Volume XX, No. 3-4. Pp. 275–377 + x. Illustrated. The Museum

EUGENICS SURVEY OF VERMONT *Fifth Annual Report: Selective Migration from Three Rural Vermont Towns and its Significance.* Pp. vii + 82. Illustrated. University of Vermont.

HOBBS, WILLIAM H *Earth Features and Their Meaning* Second edition, revised. Pp xxxvii + 517. 508 figures Macmillan. $4 50.

JENNINGS, H S. *Behavior of the Lower Organisms.* Pp xiv + 366 144 figures. Columbia University Press. $4 50

MARK, H. and R. WIERL. *Die experimentellen und theoretischen Grundlagen der Elektronenbeugung.* Pp. 124 60 figures. Verlag von Gebruder Borntraeger, Berlin

NATIONAL RESEARCH COUNCIL *Report of the Committee on Sedimentation 1929–1930* Pp 97 Division of Geology and Geography, The Council. $1 00.

THOMAS COMPANY, ARTHUR H. *Laboratory Apparatus and Reagents* Selected for Laboratories of Chemistry and Biology in their Application to Education, the Industries, Medicine and the Public Services. Pp. iv + 828 + 35 The Company.

WEINMANN, GEORGE H *A Compendium of the Statute Law of Coroners and Medical Examiners in the United States* Pp 240 The National Research Council. $3 00.

---

[1] A. S Pearse, "Autotomy in Holothurians," *Biol. Bull*, vol xviii, 1909

[2] J. W Scott, "Regeneration, Variation and Correlation in Thyone," 1914.

SCIENCE

Vol. 74 FRIDAY, OCTOBER 23, 1931 No. 1921

The Next Twenty Years PROFESSOR HANS ZINSSER 397
Obituary:
Thomas Alva Edison 404
Scientific Events
Conferences on the Calendar and on Meteorology, Techno-chemical Lectures of the Mellon Institute, The American College of Surgeons; Gold Medals in Recognition of Work in Yellow Fever, Grants of the American Academy of Arts and Sciences, Appointments of the Carnegie Institution of Washington 405
Scientific Notes and News 408
Discussion
On a Possible Explanation of the Difference in Wave lengths of the Spectral Lines of a given Element produced on the Sun and on the Earth PROFESSOR FERNANDO SANFORD *Bottom Temperatures in Deep Lakes* DR. STILLMAN WRIGHT. *Metabolism of Cystine and Methionine* DR RICHARD W JACKSON and RICHARD J BLOCK *The Transformation of Carotene to Vitamin A in Vitro* DR HAROLD S OLCOTT and DUANE C. MCCANN *Conical Snowflakes*: WILLIS W WAGENER 412
The American Association for the Advancement of Science
The Host Institution and Hotel Headquarters for the New Orleans Meeting DR. CHARLES F ROOS *Section F (Zoology) at New Orleans* PROFESSOR GEO. T HARGITT *Section E (Geology and Geography)*: PROFESSOR KIRTLEY F MATHER 415
Scientific Apparatus and Laboratory Methods
An Apparatus for Determining the Purity of Limestone in the Field DR. PAUL EMERSON *A Simple, Quick and Inexpensive Method of Preparing Lantern Slides* P E REID 418
Special Articles
A Natural Copper Deficiency in Cattle Rations: DR. W M NEAL, DR. R B BECKER and PROFESSOR A. L SHEALY *Decrease in Rate of Oxygen Consumption under the Influence of Visible Light on Sarcina lutea.* BORIS B RUBENSTEIN 418
Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa. Garrison, N Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE NEXT TWENTY YEARS[1]

By Dr. HANS ZINSSER

PROFESSOR OF BACTERIOLOGY AND IMMUNOLOGY, HARVARD UNIVERSITY

INTRODUCTION

THANKS to the new understanding which has pervaded American medicine during the last forty years, the dedication of a great hospital becomes at the same time the foundation of a new educational institution. For of all the beneficent changes which have come with the reorganization of medical education, the home-coming of the schools and hospitals to shelter under the wings of the universities is perhaps the most significant and important. By this, medicine has taken its rightful place as the science of human biology in which the laboratories form the bridge over which thought and method of the fundamental sciences find their way to the arts of the clinic and the operating room. Here in these splendid buildings, in the coming years, countless thousands will find comfort and relief from pain, new hope and the postponement of sorrow. And the old traditions of our profession will be upheld, to apply our wisdom and our best skill to all who may have need of them, regardless of the trivial differences which, under all other circumstances, keep men distrustful and apart. But here, too, the ranks of our profession will be renewed, year after year, with younger men, wiser than we—if wisely you train them; stronger in purposes of kindness and human understanding, learned as we could not be, and more skillful.

In all human affairs there is a curious lag between the acceptance of high principles and the application of such understanding to practical purposes In politics, to realize this, one need only sit in the gallery of Congress and remember that Plato wrote "The Republic" 2,400 years ago. In religious thought we are nineteen hundred and thirty-one years along, and it is best not to say anything more about it. In medicine, the dependence of progress on the disciplines of chemistry, physics and biology has been impressed upon us since the beginnings of the 19th century; and only now are we finally organized, within great universities, as a technical branch of learning, where medicine can be carried forward on the currents of thought which flow from the fundamental sciences.

---

[1] Address given at the dedicatory exercises, the new Lakeside Hospital, Cleveland, Ohio, June 17, 1931

The real beginning of this new spirit, for America, was made in 1876, when Huxley, at the dedication of the Johns Hopkins, defined the cooperation between universities, medical schools and hospitals, more or less in the form in which these principles are now accepted, after many delays and false starts Indeed, they have needed so much vigorous reiteration of recent years by Mr Abraham Flexner that, had not Huxley died when Mr Flexner was a youth, we might say that in this particular aspect of the problem, by a sort of prophetic inspiration, Huxley had taken the words out of Mr Flexner's mouth As it is, we can say that Huxley is great, and that Mr Flexner is his prophet! I say these things in all admiration, for, having differed in many things from this prophet in the past, now that the smoke of battle is blowing away in the breezes of a new day, I see how much on the whole we owe him as a valiant combatant for first principles

During the last twenty years we have passed through our period of storm and stress, but they are over and we can say "The Golden Age which a blind tradition has hitherto placed in the past is here and now before us" Of 166 medical schools which existed in 1910, about 66 are left to-day And these are educating a sufficient complement of doctors for the needs of our nation, incomparably better in quality than their predecessors The competence of our faculties, the selection of our students and, above all, our material resources have improved at a rate which no other educational movement has ever experienced in an equal period Indeed, in regard to physical equipment, those of us engaged in the quiet pursuit of our professions have often listened, with wistful though admittedly short-sighted consternation, to the clattering of the golden cloudbursts on the roof, knowing that they would call us away from our test tubes and microscopes to blueprint and catalogue

But we are approaching the end of the period of rapid expansion There will no doubt be other dedications of needed hospitals and medical schools after this one, and though development will not suddenly cease, it will assume a slower tempo. We can look forward, in the near future, to a period of increasing stability during which we must grow into our enlarged opportunities by a greater generosity of effort The fields of our endeavors have been fertilized with a beneficence and a public confidence unheard of in the history of education. It is the privilege of those of us, who are for a short time their tenants, to till them for the future harvests. And the time has come when we must stop to consider that the problems confronting us demand qualities and methods different in many respects from those most important during the transitional period of growth. The last twenty years have been given to the forging of our tools. During the coming twenty we must learn worthily to wield them.

II

It is with some trepidation that I venture to speak first of questions of administration. The specialist is expected to stick to his last, and the ideal professor is usually regarded as the one who sits in the institutional corner assigned to him, pulling out scientific plums and being otherwise a good boy But it is apparent even to the academic Jack Horners that the time-honored conception of universities as democracies of scholars—everything else being subsidiary—has changed

It would be stupid to under-estimate the value of sound administration. It would be ungrateful to withhold acknowledgment for the tact and ability with which unselfish men, often themselves talented scholars, have given their strength wholly to administration during the emergency period It was natural that adjustment and change should have led to a concentration, in the hands of administrators, of powers which, in times of normal academic development, were lodged in those of the scholars It was not only natural, it was probably a necessary condition without which the new progress could not have been achieved But, recognizing this, we should also understand that, with the subsidence of the emergencies of organization, a certain amount of administrative demobilization must be undertaken When, in a previous address, I insinuated that in our institutions of learning the administrative tail was beginning to wag the academic dog, I was mildly admonished as "captious and unreasonable" by a friendly critic from one of the foundations, who wrongly inferred that I was alluding to the power of the hand that held the purse strings This power undoubtedly exists, and must probably continue to exist, but it has never, in my own experience, been abused in intra-academic relations. The problem is more subtle than that Business management there must be, and in such affairs the true administrator is the most valuable guide and adviser a sensible faculty can possess. Deans there must be as well; but a leader in the scholastic sense and an administrator in the sense of material efficiency are not hatched out of the same egg As Mr Flexner says "Efficiency in administration and fertility in the realm of ideas have nothing to do with each other." The budgets must be balanced and this is one function But educational initiative, influence over appointments, policies of curriculum and university relations are another, which require leadership of another sort, the qualities of a scholar among scholars. If we are to succeed in the coming period of intellectual ripening as we have—thanks to temporary centralization of power during that of material expansion—the two functions must again, to some extent, be separated, and the purely administrative mechanism be carried out mechanically, as is its nature, subsidiary to and under the guidance of leaders whose interests and hearts are primarily with education and sound scholarship, secondarily with management.

For the guidance of an institution the success of which depends upon the imponderable values of spirit and intellect is not the mechanical driving of a machine made of iron and steel. It is more like the riding of a thoroughbred, an organism with a nervous system and a temperament. Any one with strong legs can stay on. But the riding is in the lightness of the hand and the feeling of being one with the horse. We must find our way back, or part way back, to the older conception of academic leadership, avoiding the estrangement between faculty and management which these feverish days of reorganization have threatened to establish. That this can be done without radical changes or great struggle I confidently believe, for it is more a change of point of view than one of actual method. Indeed, in some of the more rapidly stabilizing institutions the force of intellectual tradition is automatically bringing it about. And while the distinction I make appears nothing more than a trivial shifting of emphasis to some of my administrator friends, it is this type of subtle difference that distinguishes the fine from the commonplace in men and in institutions. And the quality of American medicine in the future will, to a large extent, depend upon the decisions we reach now in regard to scholarship and administration, which is to lead and which to follow.

That a solution for this problem is not impossible is apparent in the manner in which, for several hundred years, the German universities have managed to run smoothly under a system of rotating rectors and deans who remain integral and often distinguished members of the teaching force, while the mechanics of institutional government keep the engine in even motion, without exerting any pressure whatever upon scholastic matters. To a certain degree, also, it seems to me, a similar system has from the beginning been not unsuccessful in the Johns Hopkins Medical School. The supervisional influence exerted in the German institutions by the ministry of education would automatically be supplied, with us, by the central university authority.

I feel hopeful, therefore, that in spite of our national overemphasis upon administrative perfection, a simple way can be found to keep our medical schools and hospitals under the intellectual guidance of those most competent to run them, without in any way sacrificing that minimum of orderly management which, like an automobile engine, is most effective when it is least audible.

III

As we approach a state of reasonable stabilization, moreover, and the immediate need of powerful financial support becomes less pressing, it is to be hoped also that there will be a permanent and normal adjustment of the relationship between institutions of learning and the great foundations. These have entered the educational world as a sort of fourth estate, a distinct contribution of American benevolence to the history of education and, so far, almost uniquely American. Except for relatively few institutions, the present favorable conditions of medical schools would have been impossible without them. Their influence has been of incalculable benefit, not only by their splendid munificence but, to an almost equal degree, by their initiation of the serious study of educational methods, critical analyses and suggestions for reform. That Bulletin No. 4 of the Carnegie Reports by Abraham Flexner was the catalyst which started the fermentation that converted the sour state of affairs of 1910 into the clear and strong situation of to-day, no one can sensibly question. But there is equally no doubt that new and important problems have resulted from the creation of a power entirely independent of the organized educational system and capable of great influence over this system by the control of enormous funds. When I expressed this view in 1927, disagreement came from many directions. But after all, we have at the present time some measure by which we can estimate whether or not there was just reason for my apprehensions. The question which ten years ago agitated medical education most violently was that of the "full-time" or "part-time" direction of teaching clinics. The subject was discussed *ad nauseam*. Francis Peabody, in his published letter to Longcope, "The Soul of the Clinic," says: ". . . I have become as tired of the discussions of full-time teaching as I am of discussions of the 18th Amendment." And that the sheep were not all on one side and the goats on the other is clear from the subsequent paragraphs, written by this—perhaps the greatest of the younger leaders of clinical medicine of that time. Yet to-day the medical schools of the following universities—Johns Hopkins, Washington University of St. Louis, Yale, Columbia, Chicago, Cornell, Vanderbilt and Iowa—all of them considerably endowed by the Rockefeller Foundation, have adopted the full-time system more or less in the form advocated by some members of this foundation and opposed by many leaders of the medical profession and by not a few administrators. This may of course be due to the fact that these institutions have all recognized the greater wisdom of the plan. To some of us, wavering in our belief in Santa Claus, it would appear at least not impossible that willingness to adopt an educational policy may in some cases have been subconsciously influenced by the knowledge that such receptiveness to a new idea could, over night, convert an institution struggling to keep its head above water into an affluent one possessing all the material tools for fine performance and future expansion Accurate controls in this reasoning—which, as a bacteriologist, I would desire—are lacking, since I know of no institutions that have been offered the money and have refused it But, on the other hand, I know of others that now have neither the full-time system nor the money

I have no intention of implying by this that the accepted plan is not an excellent one, though I am strongly of the opinion that it is not likely to produce authoritative figures in clinical medicine comparable to Strumpell, Nothnagel, Neüsser, Kraüs, Friedrich Muller, Widal, Osler, Janeway, Delafield, Shattuck and Walter B James Neither do I wish to imply that the motives of the accepting institutions were mercenary ones since, as a reaction to the methods of the old proprietary medical school and as a rigid experiment toward the scientific developments of the clinic, the plan did and does recommend itself to many serious students of medical education I wish to illustrate by these considerations merely that the indirect power of foundations to stimulate fundamental changes in an educational system is a great one, and that the decisions and opinions of self-perpetuating boards of foundations may determine policies in the most important department of civilized society—namely, its educational system And it appears to me unlikely that, except by occasional fortunate accident, the judgment of foundation administrators on educational problems can, in the long run, be as wise and sound as that of the teachers who are active in the universities and in whose hands responsibility for the development of this phase of our national life must remain

As a matter of fact, I have a feeling that time will adjust these difficulties automatically Permanent agreements between donor and recipient are improbable, and there will be no reason, therefore—as the necessity for financial assistance becomes less pressing—why the universities should not gradually grow away from tendencies they consider erroneous, and again develop naturally, without extraneous influence And we must grant the gentlemen of the foundations that they are doing their best to draw into their deliberations the wisest consultants they can obtain.

Most of them would probably agree with the view that the future usefulness of the great foundations will greatly depend upon the establishment of a relationship in which, while retaining the power to grant or refuse assistance to specific requests, the foundations will neither directly nor indirectly wield any influence over the initiation of academic policy or over university appointments or investigations.

Granting that such a relationship can be brought about, American education will be enriched beyond that of any other country, by the benevolent impulses that have led to the establishment of foundations.

IV

It takes three or four years to erect a great group of buildings It takes thirty years to train an investigator or teacher and ten more to ripen him into distinction It was inevitable that the most difficult problem of our sudden aggrandizement should be that of giving the breath of life to our new institutions with men and women capable of doing them credit. But things have not gone too badly with us in this respect The gods who take care of children and democracies gave us a few leaders in the dawn of our critical period whose influence guided us when the emergency arose The pupils of Osler, Delafield, Janeway, Mall, Huntington, Jacobi, Halsted, Shattuck, James, Vaughan and some others have filled the chairs of most of our important schools. Welch, Howell, Abel, Simon Flexner, Hektoen and Theobald Smith are with us still Under their direct teaching and influence we have drawn freely on the great schools of Europe and have made much of their methods and wisdom our own. To be sure, under the pressure of the transitional period, many brilliant young scholars were sacrificed on the wheels of organization, interrupted in the best years of early production and set to work developing great departments The younger Ostwald is reported to have said of this: "When the Americans discover that a man is superbly fitted for some type of scientific work, they reward him with a position in which he can no longer pursue it" Deplorable as this has been, it was both inevitable and sound, since it followed the principle that no one can properly direct a department who is not professionally competent in the subject with which it deals And time will correct this by the simplification of administrative intricacies as stabilization proceeds Nevertheless, our most difficult problem is still this one of personnel, and it will probably take another decade before the supply of highly trained teachers, clinicians and investigators is adequate for the needs of our new institutions. And to meet this need is one of the highest responsibilities faced by those of us who are privileged to play a small part in this development.

Meanwhile, the reproach is still heard that our best schools are training poor investigators instead of good doctors. In a modified form this complaint is an old one. Francis Bacon says: "Physicians are, some of them, so pleasing and conformable to the humor of the patient as they press not the true cure of the disease, and some others are so regular in proceeding according to science for the disease as they respect not sufficiently the condition of the patient. Take one of a middle temper, or, if it may not be found in one man, combine two of either sort" What the new medical teaching is trying to accomplish is to train for the "middle temper," in which neither the pleasing art nor the procedure according to science shall be neglected.

But the reactionary voices are growing feebler as the quality of our present graduates is being appraised It is more generally acknowledged that, in a rapidly changing science, the two activities, investigation and teaching, are inseparably linked True teaching is what Carlyle called "Thought kindling" "How can he teach," he exclaims, "who has no live coal within him, but is all burnt out to a grammatical cinder?" It is true, of course, that occasionally great teachers have made few original contributions But such men have usually approached their subjects by a method of sifting the right from the wrong which, in itself, is a sort of research into true understanding, and in this way have founded schools of investigation There have been many of these indirect investigators in the history of medicine. In our own country there have been Osler, Welch and some others who have signed many of their important contributions to the medical sciences with the names of innumerable pupils whose minds were the materials on which they carried out their experiments. There are others at the opposite ends of the scale, to whom the classroom and the student laboratory is an annoying disturbance, and who must hunt alone. But even the greatest of these have pupils and assistants Only, their methods of teaching take a different form and reach a smaller number of more highly specialized minds. Between the two extremes are the larger number of men and women who are talented investigators and who take keen pleasure and profit from contacts with younger associates intent on similar purposes.

For all these there is room in the modern medical school and hospital. There is no room, however, for those to whom the act of instructing is a mechanical thing; who are content to shuck down to the feeding herd the dry hay of old harvests. For medicine, like all biology, is in a strange stage of development at which the pupil is often wiser than his master Few men on the faculties, except perhaps a small group of the biochemists, are as well grounded in the fundamental contributory sciences as the most gifted of their students. To do our difficult duty to these disciples we must remain students ourselves and be capable not only of telling them what is known to-day, but of pointing out to them the goals they may attain which a too short life has placed beyond our reach We must teach beyond ourselves. "Über dich hinaus sollst du zeugen," as Nietzsche said If we perform our allotted tasks in this sense, these young men and women will gain from us not merely the meager store of to-day's understanding but, from our curiosities and our laborious efforts to conquer a little of to-morrow, they will gather velocity to carry them farther than we can hope to go Less than this is not true teaching

And it is at the present stage of our development that this type of relationship between teachers and the taught is of particular importance The rapidity with which the exacter sciences of chemistry, physics and mathematics are penetrating medicine makes collaborators of the experienced biologist and the younger student who comes fresh from the fundamental laboratories As much error can be committed by the premature attempt to apply exact mathematical reasoning, accurate enough in simple systems, to the complex processes of living matter, as by neglecting available physico-chemical knowledge in the biological approach The two methods are dependent upon the same kind of reasoning But while the more exact sciences gain much of their information by creating their own conditions of study in systems sufficiently simple to permit absolute conclusions, nature fixes the conditions which the biologist must investigate It is only when, by his trial and error experimentation, he has isolated a set of phenomena that the chemist or physicist can profitably take hold It is more important than ever before, therefore, that teachers and pupils should regard themselves as overlapping, consecutive generations of students whose relationship must be, for the service of knowledge, quite different from that of the old pedagogic one of less actively advancing eras.

Of course there are certain cornerstones and retaining walls of accepted fact that must first be laid This is, or should be a simple mechanical affair—easily arranged. Real teaching begins at the jumping-off place.

V

But in this matter of research there is still much that awaits adjustment. The very point of view which I have expressed has placed a premium on the mere activity of investigative effort regardless of its intelligence or results. We have developed the habit of judging men for positions by the perusal of the titles of their publications, and a list three pages long is more formidable than one of a few lines. There is also a peculiarly sensational and sentimental appeal in medical discovery, and we are living in an age in which cheap performance, skilfully vulgarized, may have an enormous advertising value. And institutional rivalry, bidding for support, has had a tendency to foster the submission of results to public and inexpert applause before they have been passed upon in the rigid forum of technical criticism.

There has been, in consequence, a hot-house forcing of medical investigation which, together with some very brilliant and useful growth, has nourished the weeds of much second-rate material. There has also developed a curious halo about research which has exalted it above other and, in the absence of talent, more useful and less expensive methods of occupying time.

These tendencies have been further intensified by the strange circumstance—peculiar to our present development—that, for the time being, available funds have often outstripped our abilities to use them wisely. In the fields of cancer and tuberculosis particularly, high-minded philanthropists have hoped that money could engender ideas, instead of being merely the fertilizer which can aid the sprouting of the living seed of a thought. For this reason, to-day, much work is undertaken merely to justify expenditure, and, in well-equipped laboratories, many a man and woman is patiently sitting on a lifeless idea, like a hen on a boiled egg, or is spending time and money transposing into complicated notations old tunes that have been adequately played in C major.

Undoubtedly a certain amount of such gnawing at dry bones is inevitable, since pedantry—not strong enough to shove a spade into the rich soil of new fields—has ever been attracted to the dust-bin. And also there must be trial and error in regions of thought in which the unknown is so vast compared with the narrow paths of the known. And the most intelligent endeavors may lead into blind roads from which retreat is the only return to the highway.

To reduce such waste to the necessary minimum, and to prevent the vulgarization of science by the introduction of a spirit of rivalry and réclame is largely the responsibility of all of us, old and young, who are privileged to cooperate in hospitals and schools. It is not only a matter of teaching and studying in the manner which I have indicated, nor is it entirely one of doing our own work honestly and with modesty. It is necessary, in addition to this, to maintain a strong consciousness of the dignity of this type of occupation and freely to encourage into it only those of whose talents and training, and above all, of whose reverence for truth we are convinced. Especially must we not lose the spontaneity of our reactions of joyous admiration for a good job well done by another, and of contempt for cheap performance. Finally, though abandoning none of our critical faculties, we must be extraordinarily careful not to become so academically conservative, as our vessels grow harder, that we extinguish, with a flood of doctrinaire convictions, young thoughts too original and foreign to accepted theory for our own ready comprehension.

This part of it is the task of those of us who are working in the ranks—a heavy one and a difficult program in which few of us can hope entirely to succeed. In this regard, however, we may look into the future with confidence, because in a constantly increasing number of the newly organized institutions there are growing up groups of younger men whose training has been far sounder than our own and whose standards are certainly as high.

But there are other factors involved in the situation which are at least of equal importance, and which, with the passage of time and stabilization, will have a decisive influence. When buildings and equipment have been provided with a splendor sufficient to satisfy the most chauvinistic local pride and the ambitions of executives, the funds which subsequently become available will, let us hope, be freed for the development of the flesh and blood of universities—men and budgets. And may the wise administrator be wary of accepting funds for special projects dear to the hearts of donors—cancer, tuberculosis, institutes of human relations, eugenics, etc.—and encourage the accumulation of unrestricted gifts. Scientific thought, like poetic inspiration, must be allowed to circle indefinitely, like a carrier pigeon, to find its own direction of flight. We believe that in many American institutions large funds are relatively sterile because they can be used only for definite purposes in which progress, impossible for the time being, awaits ideas and methods not yet available. And the great strength of Trinity College, in Cambridge, would seem to lie in its command over large and unrestricted resources with which it can permanently support a group of mature and distinguished scholars who can explore wherever the trails of curiosity lead them.

Let us not forget that Archimedes had the idea of specific gravity while taking a bath; that Descartes was lying in bed when he evolved coordinate geometry, and that Isaac Newton—though I don't believe it, is said to have drawn deep deductions first in an apple orchard. On the other hand, I do not wish to be misunderstood as meaning to sponsor the policy that universities should pay men large salaries for taking baths, lying abed and drowsing under apple trees.

VI

Devotion and good sense are not lacking in our institutions and many of the matters of which I have spoken are growing pains which will not, if recognized early and energetically treated, affect our hearts Our great asset is the increasing number of young men and women, who in a commercial age and in a country of wide opportunity are offering themselves for our work Partly, this is due to the higher type of pre-medical education, partly to the careful selection of material by medical schools, and again to the cultivation of that type of teaching which I have outlined Also, however, I feel confident, it is due to the growth of a spirit of enthusiasm and idealism in many of the present generation of students which is perhaps one of the wholesome reactions against the exaggerated materialism of the last twenty years Our responsibility then is not only to train and select but also to create conditions which will hold the enthusiastic and talented in the clinic and the laboratory This is to a large degree already attained by the opportunities for work that our new institutions provide To a greater degree, however, it is also an economic question And this brings me to the sordid problem of salaries.

The complaint that we can not expect to recruit the best brains of the country into academic life, owing to the meager economic future offered in these occupations, is to some extent justified in fact Not so long ago science in America was a calling at which one could not make a living until after death Conditions have rapidly improved and should still improve considerably, especially in the cases of the middle grades—mature men and women who should not be forced to leave important work in well-organized places merely because only one living salary is provided in the budget for the director of the department. But unfavorable comparisons of academic remuneration with the enormous incomes of industrial administrators, corporation lawyers and bootleggers are quite beside the point. The answer of the future will perhaps be that the incomes of scientists will moderately increase, but surely that the exaggerated wages of some other occupations will diminish For an academic salary of ten or twelve thousand dollars is a more normal social phenomenon than one of a hundred thousand for the manufacture of chewing gum or the authorship of a romantic advertisement for a mouth wash This is a matter of opinion. It is an easily calculable fact, however, that the universities can never hope to compete with business or the practicing professions in this respect, simply because there is not enough money in the country to make this possible. Though in a few instances attempts seem to have been made in this direction in order to "put over" the full-time clinical plan, I believe this to be an abnormal phenomenon of artificial development which will pass with another generation. But were it possible for universities to enter in this financial competition for brains, would it be necessary or even desirable?

It is just, of course, that academic pay should be respectably adequate to provide the legitimate needs of a cultivated family of moderate size There is such a thing, however, as being civilized beyond the necessity of great wealth And those who have attained this level of personal civilization know that they must choose in the sense of the Chinese philosopher Yang Hon, who said "The man who thinks only of amassing riches is not humane, and he who thinks only of leading a humane life shall not be rich"

There are passing through the hospitals and universities of this country more youngsters who subscribe to this doctrine than any one knows except those of us who are daily at work with them Most of them have thought it over and come to the conclusions which Carlyle paraphrases from Confucius: "If the search of great riches were certain of success—though I become a groom with whip in hand to get them, I will do so As the search may not be successful, I will follow after that which I love"

The temper of that type of mind which is attracted to the sciences and the arts is usually emancipated from the obsession for quick riches which other occupations are so apt to strengthen These young men and women that come to us in annually greater numbers are attracted to our calling because a higher type of training and better opportunities for work have aroused their spirits They have no ambition for great financial success They are willing to forget about this entirely if they can be offered rewards sufficient to permit them to live lives of normal human relations—marriage, children, books and the pride of economic independence—not only after middle age has brought recognition, but in the formative and most productive years—which now are the most trying and full of disturbing anxieties All this—and it is not expensive—is within the possibilities of the financial resources of our present university medical schools And, given this, there are more of these young men and women of force and ability than most people know, who deliberately choose the great adventure of trying to write something of themselves by their own work and thoughts into the records of time.

And, in our profession, in addition to the intellectual appeal, there is the legitimate one of a humane impulse—directly or indirectly to aid in alleviating sorrow and sickness and even, by some fortunate combination of chance, labor and clear thinking, once in so often to parry the scythe of death.

We are confronted with many problems and many responsibilities for these coming twenty years. But the last twenty have put the tools into our hands. We need have no fear of failure if we remain sturdy in our trusts and put our faith in the younger generation.

And here in Cleveland you are again expressing this vigorous faith in the future which has characterized the entire history of the Western Reserve—a faith which inspires the undertaking of great beginnings which you know will be carried on eventually by younger hands in the high spirit with which they were begun In this great and splendid institution, in which all the humane and benevolent forces of your city are cooperating you will solve all the problems that may arise from the rapidity of development which renders our own era of medicine a difficult but a particularly fascinating one You may, at times—with all of us—fail to strike that delicate balance between the practical things of life and the more intangible qualities of spirit and intellect, which must be found in order that our profession may continue to perform its full functions in the service of civilization These temporary fluctuations which occur in all difficult human undertakings are like the swinging from right to left of a vessel in the wash of a heavy sea—but they make no deviation from the eventual true course when wise and vigorous hands are on the wheel You know where you are going, your course is charted, and you have already a great tradition to drive you forward.

Of few things can we foretell the future. In these days of world transformations no one can foresee the events that are to come. No man can much affect them except by lifting his hand and mind honestly to the tasks that lie immediately before him But in this is our profession more blessed than all others. Whatever the changes or trials that an uncertain future may hold, nothing can alter the intrinsic purposes of medicine, the very definition of which must be stated in words of action, to increase in wisdom and skill for the relief of suffering and the solace of sorrow—to serve men, their bodies and their minds—indiscriminately in a spirit that transcends social, racial and national distinctions In all the rivalries and hatreds and mutual distrusts that hold the political and economic world in a grip of terror, medicine has no part It is the one activity that, through these years of upheaval and revaluation of ideas and institutions, has had no need to alter its standards or its aspirations; it has known no enmities and recognized no national boundaries Epidemic, sickness, physical suffering wipe out all this, and unite all men in sympathy and human equality. And all those in the world whom a kind fortune has permitted to devote themselves to this profession, rejoice and are grateful for the work you are inaugurating to-day

OBITUARY

THOMAS ALVA EDISON

1847–1931

Thomas Alva Edison died in the early morning of October 18 From the tributes from many sources printed by *The New York Times*, the following from Mr Hoover and from a number of scientific men are quoted.

It is given to few men of any age, nation or calling to become the benefactor of all humanity That distinction came abundantly to Thomas Alva Edison, whose death in his eighty-fifth year has ended a life of courage and outstanding achievement His lifelong search for truth, fructifying in more than a thousand inventions, made him the greatest inventor our nation has produced, and revolutionized civilization itself He multiplied light and dissolved darkness, he added to the whole wealth of nations He was great not only in his scientific creative instinct and insight but did more than any other American to place invention on an organized basis of the utilization of raw materials of pure science and discovery He was a rare genius He has been a precious asset to the whole world.

Every American owes a personal debt to him It is not only a debt for great benefactions which he has brought to every American, but also a debt for the honor he brought to our country By his own genius and effort he rose from a newsboy and telegrapher to the position of leadership among men. His life has been a constant stimulant to confidence that our institutions hold open the door of opportunity to those who would enter He possessed a modesty, a kindliness, a staunchness of character rare among men. His death leaves thousands bereft of a friend, the nation bereft of one of its notable citizens and the world bereft of one of its greatest benefactors. I mourn his passing as a personal friend over a quarter of a century.—Herbert Hoover, President of the United States.

It has seldom fallen to any one man to be of such service to humanity. The world mourns a great benefactor.—Samuel W Stratton, chairman of the corporation of the Massachusetts Institute of Technology (dictated a few minutes before his own death).

I think his reputation was great outside America. One could not go anywhere in the world where he was not considered the greatest inventor and help to mankind. He was kind and considerate and a good friend.—G. K. Burgess, director of the Bureau of Standards.

In my opinion Mr Edison had a greater influence on the world than any other American.—Karl T. Compton, president of the Massachusetts Institute of Technology.

Edison, through his discovery of how to preserve the spoken word, made man and himself immortal. What greater is possible in practical achievement?—Robert A. Millikan, California Institute of Technology.

At the dawn of the electrical age, a little over fifty years ago, Edison appeared like a heaven sent pioneer. His burning enthusiasm and undaunted courage and perseverance succeeded in creating in 1882 the incandescent electrical lighting system, which has not experienced an essential change since that time. This was his greatest achievement and entitled him to immortality.—Michael Pupin, Columbia University.

Edison was truly one of the great Americans. His contributions to science have been outstanding.—John C. Merriam, president of the Carnegie Institution of Washington.

Thomas Edison used science for the benefit of mankind to such a high degree, and brought science and the scientific method into such high repute in the public regard, that it is an open question which of these two great contributions to modern civilization is the greater. Certain it is, that no other man of our generation has made a larger or more inspiring contribution.—Vernon Kellogg, permanent secretary of the National Research Council.

With the insight of genius Edison made trial and error combined with industrial organization a method of research. He was one of the greatest men America has produced, leading in the applications of science to industry that have made possible a new civilization based on democracy, universal education and general welfare.—J. McKeen Cattell, editor of Science.

America has lost one of its most famous citizens and the world one of its greatest benefactors. In a very real sense Edison was the founder of our electric era. What a fine thing it would be if such a useful and inspiring personality could be granted a span of life commensurate with his value and usefulness to the world. If so, Edison would have lived for ages.—Edwin W. Rice, Jr., honorary chairman of the board and former president of the General Electric Company.

Edison was doing—and is doing—more to advance our human affairs and interests than any one I know. I repeat "is doing" because his example of actively trying to lift us continually a peg higher in our civilization by strenuous personal effort is now actuating countless youth of all lands.—Willis R. Whitney, director of the Research Laboratory of the General Electric Company, Schenectady.

Edison demonstrated to the world the enormous practical importance of electric power and its applications. Few men have ever benefited more of their fellow-men.—Irving Langmuir, associate director of the General Electric Research Laboratory.

Among all the people of the earth no name has been mentioned with greater admiration than that of Thomas A. Edison, the greatest inventor of his time. An adequate appreciation of all Mr. Edison's merits can not be encompassed in brief space, but this much can be said here: not only his work but his personality especially was of sublime grandeur.—Oscar von Müller, Deutsches Museum, Munich.

In Edison the world loses one of the greatest technical geniuses who ever lived. Though Edison himself very often equated genius with application, we know that his successes can not be accounted for by application alone. In Edison intuitive thought and exact weighing of all technical and economic problems were united with unparalleled perseverance in pursuit of his problems to such a degree that thereby he became for us the archtype of inventor.—August Carolus, the University of Leipzig.

The passing of Edison is a great loss to the world and especially to science and industry. Not only was the world indebted to Edison for innumerable creations of his own brain, but for his aptitude in adapting to practical purposes the ideas of other inventors, which but for him would have remained impracticable.—The Duc de Grammont, Paris.

With the passing of Edison one of the world's greatest benefactors leaves us. What he has done for business, pleasure and philanthropy can not easily be calculated. But some idea of what the world would be without his inventions, his self sacrificing labors, can be gathered if we try to live for a day in busy centers without the use of the telephone. He was a great and constant inspiration to me throughout my life.—Guglielmo Marconi.

In Edison, one of the great technical inventors to whom we owe the possibility of alleviation and embellishment of our outward life has departed from us. An inventive spirit has filled his own life and all our existence with bright light. Thankfully we accept his legacy, not only as a gift of his genius, but also as a mission placed in our hands. For to the new generation falls the task of finding the way for the right use of the gift given to us. Only if it solves this task will the new generation be worthy of its inheritance and become really happier than former generations.—Albert Einstein.

SCIENTIFIC EVENTS

CONFERENCES ON THE CALENDAR AND ON METEOROLOGY

Professor Charles F. Marvin, chief of the U. S. Weather Bureau, was a representative of the State Department at the fourth general Conference of the Committee on Communications and Transit of the League of Nations, which met at Geneva, Switzerland, on October 12. This designation was in response to a request from the League of Nations that this country be represented at the conference, especially in connection with the question of the simplification of the calendar, which is one of the agenda.

Professor Marvin is vice-chairman of the National Committee for the United States on Simplification of the Calendar, which is an unofficial committee consisting of representative men and women interested in the improvement of the present calendar His attendance at this conference was as an expert observer for the State Department and not as chief of the Weather Bureau.

In addition to attending the meetings of the League of Nations committee, Professor Marvin attended, as chief of the Weather Bureau, the meetings of the International Meteorological Committee and a meeting of the executive council of that committee. These meetings were held at Locarno beginning on October 5

The International Meteorological Organization, which consists of the directors of all the meteorological services of the world, meets every six years The International Meteorological Committee is a subcommission of the major body and has 21 members Its meetings are held on the call of the president, usually every two years There is an executive council, composed of five members, which is charged with the conduct of the administrative affairs of the main body. Professor Marvin is a member of both the subcommission and the executive council This year these are meeting at the same time at Locarno

The program of the International Meteorological Committee consists of the consideration of the reports of the president, secretary and other officers, as well as meteorological subjects, among them being that of the polar year program One of the items to be handled by the executive council is that of selecting a permanent secretary of the major organization, the headquarters of which are to be in Switzerland The secretariat is supported by the various governments concerned

TECHNO-CHEMICAL LECTURES OF THE MELLON INSTITUTE

Two series of lectures on important subjects in industrial chemistry and chemical engineering are being presented by technologic specialists of the Mellon Institute of Industrial Research during 1931–32 These discourses are delivered on Mondays, from 10 30 A M to 11·30 A M, throughout both semesters, in the fellows' room of the institute, and are open to all students of industrial chemistry and chemical engineering in the University of Pittsburgh, as well as to the institute's members

The introductory lecture was given on September 28 by Dr Edward R Weidlein, director of the institute, on "The Field and Opportunities of the Chemical Engineer" The first series of lectures entitled "Some Important Chemical Engineering Materials, Their Manufacture, Properties, Uses, and Evaluation" is being given on the following dates.

October 5, Mr H J Rose, "Coke", October 12, Mr. R. F Ferguson, "The Manufacture of Refractories", October 19, Mr S M Phelps, "The Properties and Uses of Refractories", October 26, Mr C H Geister, "The Manufacture, Properties and Uses of Lime"; November 2, Mr Tracy Bartholomew, "The Manufacture, Properties and Uses of Portland Cement", November 9, Mr R H Heilman, "Heat-Insulating Materials", November 16, Mr J. D Alley, "Abrasives", November 23, Dr S A Braley, "Iron and Steel", November 30, Dr A. W Coffman, "Corrosion-Resistant Materials", December 7, Dr W W Duecker, "Sulphur", December 14, Mr R R. McClure, "Rubber"

The second series include "Lectures on Professional Opportunities in Various Industries—What the Chemist and Chemical Engineer Have Done, are Doing, and can Probably Accomplish in these Fields," and will be given as follows

January 4, Dr F P Lasseter, "Hydrometallurgy", January 11, Mr H H Meyers, "Fertilizers", January 18, Mr E J Casselman, "Glass", February 8, Mr E. W Reid, "Solvents", February 15, Dr P. B Davidson, "Paper", February 29, Dr R N Wenzel, "Fatty Oils and Soaps", March 7, Mr E R. Harding, "Foods", March 14, Mr C. F Goldthwait, "Textiles", March 21, Dr H K Salzberg, "Paints", April 4, Dr. A G Loomis, "Petroleum Production", April 11, Dr H E Foote, "Industrial Gases"; April 18, Dr. G J Cox, "Sugar", April 25, Dr J J Enright, "Bacteriology, Chemistry and Public Health", May 2, Dr O F Hedenburg, "Insecticides and Fungicides"; May 9, Dr George D Beal, "Pharmaceuticals", May 16, Dr L H Cretcher, "Synthetic Medicinals."

THE AMERICAN COLLEGE OF SURGEONS

Dr J. Bentley Squier, professor of urology at the College of Physicians and Surgeons, Columbia University, and director of the Squier Urological Institute of Presbyterian Hospital, was elected president of the American College of Surgeons for next year at the recent New York meeting He will be inducted into office to succeed Dr Allen B Kanavel, of Northwestern University, at the next annual meeting, the date and place of which have not yet been determined As its next vice-presidents the college elected Dr. C Gordon Heyd, professor of clinical surgery and attending surgeon at the New York Post-Graduate Medical School and Hospital, and Dr W. Edward Gallie, surgeon-in-chief of the Toronto General Hospital.

At the concluding session on October 16 three honorary fellowships and 647 regular fellowships were conferred and an address to the initiates was given by Dr. Allen B Kanavel, president of the college, The honorary fellowships were conferred upon Professor Dr. Hans von Haberer, of Cologne, Germany, Professor Arthur Henry Burgess, of Manchester, England, and Sir Charles Gordon-Watson, of London

An unanticipated part of the ceremony was the conferring upon Dr Franklin H. Martin, "father" and director of the American College of Surgeons, of the title of "commendatore" of the Crown of Italy The decoration was bestowed by Emmanuele Grazzi, Italian Consul General, who said that it was upon the proposal of Premier Benito Mussolini and by order of the King of Italy in recognition of Dr Martin's services to Italy through the organization of a base hospital during the war Dr Martin already holds the Distinguished Service Medal and the Order of St Michael and St George from the British government

Dr H H Ogilvie, of San Antonio, Texas, received the college's annual "Case History Prize Award" of $500 for the surgeon who keeps the best record of case histories

On the roster of 647 new fellows of the college, elected from 1,490 applicants, were seven Canadian surgeons, two in Australia, one in China, one in England, one in Guatemala, one in India, two in Mexico, one in Panama and two in Siam

GOLD MEDALS IN RECOGNITION OF WORK IN YELLOW FEVER

THE *Associated Press* reports that after thirty years the Government of the United States has bestowed the full measure of recognition on the late Dr Walter Reed and his associates in the war on yellow fever during the years 1900, 1901 and 1902

The awards voted two years ago by the Congress were dispatched on October 2 to survivors of Dr Reed's volunteers, and to the heirs of others At least six of the bestowals, including that for Dr. Reed himself, were posthumous.

They consisted of a gold medal with the name of the recipient on one side and the words "Conquest of Yellow Fever" on the back. Congress also awarded to a number of volunteers pensions of $125 a month

In addition to that for Major Reed, the posthumous awards were for the following:

Dr Aristides Agramonte, who died recently at New Orleans, where he was head of the School of Tropical Medicine of the University of Louisiana.

Major James Carroll, survived by his wife, St. Petersburg, Florida.

Jesse W Lazear, widow, Berkeley, California.

Edward Weatherwalks, widow, Pompton Lakes, New Jersey.

Warren G. Jernegan, widow, last known address, Charleston, South Carolina.

William H. Dean, address unknown, born in Holland, Ohio, enlisted in Grand Rapids, Michigan.

Other medals went to the following:

John H. Andrus, Elmira, New York
John R. Bullard, Cuba.
A W Covington, Cohocton, New York
Wallace W Forbes, Minneapolis
Levey E Folk, Columbus, Ohio
Paul Hamann, East Moline, Illinois
James L Hanberry, address unknown, born Denmark, South Carolina.
John R Kissinger, Huntington, Indiana
John J Moran, Mexico City
William Olsen, Los Angeles
Charles G Sonntag, Jackson, South Carolina
Clyde L. West, Toledo.
Dr R P Cooke, Virginia
Thomas M England, Washington, D C
James Hildebrand, Atlanta

Those who received pensions also were Hamann, Kissinger, Olsen, Sonntag, West, Hildebrand, Andrus, Covington, Forbes, Folk, Hanberry, England, the widow of Private Weatherwalks, Bullard, Cooke and Moran

GRANTS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT a meeting of the council of the American Academy of Arts and Sciences on October 14, the following appropriations were made from the Permanent Science Fund, administered by the academy.

To Dr Leonard S Hsu, of the Princeton-Yenching Foundation, $1,000, to aid in his study of population problems in China and to help in the publication of the results therefrom in English

To Dr J. L Conel, of Boston University Medical School, $200, to aid in the collection of embryos of the eel.

To Dr. Edgar Altenburg, Rice Institute, Houston, Texas, $500, for assistance in prosecuting his investigations on the effect of ultra-violet light on the germ plasm of *Drosophila melanogaster*.

The Permanent Science Fund Committee of the American Academy of Arts and Sciences will receive requests for grants in aid of scientific research in the physical sciences, the natural sciences, and the social sciences There is no restriction as to the type of research for which these grants will be made, but special attention will be given to requests for small sums where the acquisition of such funds will make it possible for investigators to carry out researches in cases where it would be difficult or impossible without some such aid

The next meeting of the committee will be held on the fourth Tuesday in April, 1932. Requests for grants should be sent to Professor E M. East, chairman, Bussey Institution, Forest Hills, Massachusetts, by March 15, 1932.

APPOINTMENTS OF THE CARNEGIE INSTITUTION OF WASHINGTON

DR H A. SPOEHR has resigned as director of natural sciences of the Rockefeller Foundation and has resumed his former association with the Carnegie Institution of Washington as chairman of the division of plant biology, with headquarters at the central laboratory of this division, at Stanford University, California

Dr Jens Clausen, of the Royal Veterinary and Agronomic Laboratory, Copenhagen, has been appointed cyto-geneticist to the staff of the division of plant biology Dr Clausen is now carrying on his work in association with Dr H M Hall at the central laboratory of this division, at Stanford University

Dr Robert W Bates, of the department of physiological chemistry of the University of Chicago, has undertaken studies, beginning on October 1, as an associate of Dr Oscar Riddle, staff member of the department of genetics of the institution, at Cold Spring Harbor, Long Island

Dr W H W Baade, of the Hamburg Observatory, has been appointed astronomer at the Mount Wilson Observatory, dating from October 1, 1931

Dr Joel Stebbins, director of the Washburn Observatory of the University of Wisconsin, has undertaken service as a research associate of the institution, for the purpose of collaboration in studies of stellar photometry at the Mount Wilson Observatory

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will hold its autumn meeting at Yale University, New Haven, beginning on November 16 At this meeting Dr W W Campbell will preside, having been elected to the presidency in succession to Dr T H Morgan

THE executive committee of the American Association for the Advancement of Science will hold its regular fall meeting at the Cosmos Club in Washington on Sunday, October 25, with a forenoon and an afternoon session

DR SAMUEL WESLEY STRATTON, chairman of the corporation of the Massachusetts Institute of Technology, previously professor of physics at the University of Chicago, founder and first director of the National Bureau of Standards and president of the Massachusetts Institute of Technology, died suddenly from heart disease on October 18 at the age of seventy years

THE John Fritz gold medal, conferred by the four national societies of civil, mining and metallurgical, mechanical and electrical engineers, has been awarded for 1932 to Dr Michael I Pupin, professor of electromechanics and director of the Phoenix Research Laboratory at Columbia University, for his achievements as "scientist, engineer, author, inventor of the tuning of oscillating circuits and the loading of telephone circuits by inductance coils"

DR GEORGE E HALE has been elected president of the International Council of Scientific Unions, the new name of the International Research Council He succeeds M Picard Sir Henry Lyons remains general secretary

AT the recent centenary meeting of the British Association for the Advancement of Science, Sir Alfred Ewing, lately principal and vice-chancellor of the University of Edinburgh, was elected by the general committee president of the association for next year, when the meeting will be held at York The new members of the council are Dr J Drever, Professor T E Gregory, Professor H S Hele-Shaw, Professor E B Poulton and Professor A M Tyndall

AT the reception held at the University of London on September 28 to celebrate the centenary meeting of the British Association, the degree of doctor of science was conferred on General Jan Christiaan Smuts, F R S, president of the association, Professor Sir Frederick Gowland Hopkins, F R S, Sir Charles Scott Sherrington, O M, F R S, Lord Rutherford, O M, F R S, and (*in absentia*) Sir Joseph John Thomson, O M, F R S

DR JAMES ROWLAND ANGELL, president of Yale University, who was made "Chevalier" of the French Legion of Honor in 1930, has been promoted to the rank of "Officier"

DR. ALICE HAMILTON, assistant professor of industrial medicine at the Harvard School of Public Health, was given a special dinner at the recent meeting of the American Public Health Association.

DR RUSSELL M WILDER has resigned his position as professor of medicine at the University of Chicago to join the staff of the Mayo Clinic and the faculty of the Mayo Foundation Graduate School of the University of Minnesota as professor of medicine

DR KARL T WAUGH, head of the department of psychology at Long Island University, has been elected president of Dickinson College.

DR ELIJAH SWIFT, Williams professor of mathematics and head of the department in the College of Arts and Sciences, University of Vermont, has been made dean of the college, succeeding Dean George H.

Perkins, who has retired after a service of thirty-three years.

DR. E N JONES, head of the department of botany of Baylor University, at Waco, Texas, has been made acting dean of the college of arts and sciences

DR KENNETH A KOBE, of the University of Minnesota, has been appointed instructor in chemical engineering at the University of Washington He will have charge of the work in industrial chemistry in place of Dr H K Benson, who is in Washington, D C, for the year in charge of the division of chemistry and chemical technology of the National Research Council.

DR RAYMOND L TAYLOR has been appointed assistant professor of biology at the College of William and Mary and will give courses in botany and in entomology Last year Dr Taylor filled a temporary appointment as instructor of entomology in the New York State College of Forestry, Syracuse University

THE University of Alabama School of Medicine announces the following new appointments Dr Allen D Keller, professor of physiology and pharmacology, from the Yale University School of Medicine, Dr Franklin S DuBois, assistant professor of anatomy and acting executive of the department, from the University of Chicago, Dr Gene H Kistler, assistant professor of physiology and pharmacology and assistant in medicine, from the University of Chicago, Dr Marie C D'Amour, instructor in physiology and pharmacology, from the University of Chicago The following promotions have been made Dr Ralph McBurney, professor of bacteriology and hygiene and assistant in medicine, Dr Allen W Blair, assistant professor of pathology and bacteriology and instructor in surgery, Dr Eleanor A Hunt, assistant professor of microscopic anatomy, Dr Luny V Ragsdale, assistant clinical professor of medicine, Dr John McLaughlin Forney, assistant clinical professor of obstetrics

CARL W MITMAN is curator of the new division of engineering in the U S National Museum, formed in July by combining the divisions of mineral and mechanical technology In this new division the section of mechanical technology is under the supervision of Frank A Taylor, assistant curator, the section of aeronautics is under Paul E Garber, assistant curator, and the section of mineral technology is under the immediate supervision of Mr. Mitman

DR. J S WIANT has resigned from the staff of the Wyoming State Agricultural Experiment Station to accept the position of associate pathologist with the division of horticultural crops and diseases of the U S Bureau of Plant Industry He is stationed at the U S Market Pathology Laboratory in New York City

DR. WARREN FALES DRAPER, assistant surgeon general in the federal service, has been appointed commissioner of health in Virginia

COLONEL CHARLES P ECHOLS, professor of mathematics at the U S Military Academy at West Point, retired from the U S Army on October 1

PROFESSOR WILLEM DE SITTER, director of the Leiden Observatory, will lecture under the Trask Foundation at Princeton University on October 27 on "The Size of the Universe" Dr Edwin P Hubble, of the Mount Wilson Observatory, will give four lectures under the Vanuxem Foundation at Princeton on October 29 and 30, and on November 2 and 3, on the general subject of the nebulae

PROFESSOR HENRY E SIGERIST, professor of the history of medicine and director of the Institute of the History of Medicine of the University of Leipzig, has been appointed visiting lecturer in the history of medicine at the Johns Hopkins University School of Medicine for the present year Professor Sigerist will be at the Johns Hopkins University during October and November, and will give a series of lectures and courses.

DR ARTHUR E KENNELLY, professor emeritus of electrical engineering at Harvard University and the Massachusetts Institute of Technology, has gone to Japan At the invitation of the Institution of Electrical Engineers of Japan, he will deliver a series of lectures during November, before five Japanese universities, as the first visiting American professor under the Iwadare Foundation

DR J MCKEEN CATTELL, editor of SCIENCE, returned to New York on October 13, after attending the centenary meeting of the British Association for the Advancement of Science in London as the delegate of the American Association

DR A R MOORE has returned to his post at the University of Oregon after an absence of a year which he spent in Europe as a fellow of the C R B Educational Foundation While abroad Dr and Mrs. Moore worked at different times in the marine stations at Roscoff and Naples, and in the university laboratories at Brussels and Innsbruck

DR. JOHN H BRADLEY, professor of geology at the University of Southern California, has returned from a field expedition in the Inyo Mountain range with a collection of starfish fossils.

UNDER a special fellowship of the Charles Lathrop Pack Forestry Foundation, Professor Svend Heiberg, of the department of silviculture, New York State College of Forestry, a graduate of the Copenhagen and Yale Forestry Schools, has left for a four-months forest study trip in Europe. Professor Heiberg has been engaged during the last three years in examining the development of forest plantations in the State of New York and in order to supplement that work he will survey recent developments in the production of forests in Europe.

MISS MALVINA HOFFMAN, sculptress of New York and Paris, who has been commissioned by the Field Museum of Natural History to make more than 100 life-size figures, busts and heads representing all the principal races and types of mankind, has left Chicago after conferences with officials of the museum, for a trip around the world. During this trip she will make studies in the various countries from living models. The figures, which will be in bronze, will form a principal feature of a projected new hall in the museum—the Chauncey Keep Memorial Hall—which is to be devoted to the living races of man. Miss Hoffman recently completed a European trip during which she made a number of plaster casts and bronzes for the museum.

DR. A. DEFRISE, associate professor in the anatomical Institute of the University of Milan, recently a research fellow of the Rockefeller Foundation working at the Johns Hopkins University, returned to Italy on October 15, taking with him a number of Wistar Institute albino rats of the experimental colony strain to start a colony at Milan for research purposes.

A MEETING of the American section of the International Astronomical Union will be held in Washington, D. C., after the close of the meeting of the American Astronomical Society, December 28–30. New statutes of the section in conformity with the new statutes of the union will be proposed by the executive committee. It does not plan to appoint technical committees of the American section as was done in preparation for the last two meetings of the union. Members of the standing committees of the union are invited to submit to the executive committee, through the secretary, Professor Raymond S. Dugan, Princeton, any matters which they wish to have considered at the meeting.

THE Society of American Bacteriologists will hold its annual meetings in Baltimore from December 28 to 30, inclusive, under the presidency of Professor J. Howard Brown, of the Johns Hopkins Medical School. There will be a general scientific session in the form of a series of papers on "Bacterial Dissociation and Life Cycles." The program of the section on medical bacteriology and immunology is practically completed with symposia on (1) hemolytic streptococci, (2) meningococcus, and (3) immunological aspects of anterior poliomyelitis and of typhus fever.

THE Radiological Society of North America will hold its seventeenth annual meeting in St. Louis from November 30 to December 4, with headquarters and meeting place at the New Jefferson Hotel. Dr. Edwin C. Ernst is chairman of the local committee on arrangements.

THE forty-fifth annual convention of the Association of Land-Grant Colleges and Universities will be held at the Stevens Hotel, Chicago, from November 16 to 18. As in previous years, representatives of the land-grant colleges and the U. S. Department of Agriculture will attend this convention, to discuss various questions relating to agricultural education, research and extension, including also engineering and home economics. The president of the association is Dr. G. W. Rightmire, president of the Ohio State University, Columbus, and the secretary-treasurer is T. P. Cooper, dean of the Kentucky College of Agriculture and director of the Kentucky Agricultural Experiment Station and of the extension service, Lexington. The chairman of the executive committee is Dr. R. A. Pearson, president of the University of Maryland, College Park.

THE Grasselli Medal meeting of the Society of Chemical Industry will be held on November 6, at 8:30 P. M., at the Hotel New Yorker, with the American Chemical Society, the Electrochemical Society and the Société de Chimie Industrielle. Non-members are invited to attend. Ample space has been provided to accommodate a large attendance in addition to those who attend the dinner preceding it. At this meeting the Grasselli Medal will be presented to Dr. L. V. Redman. The program will be as follows: "Accomplishments of the Medallist"—F. W. Willard; "Presentation of the Grasselli Medal"—D. D. Jackson; "Research as a Fixed Charge"—L. V. Redman. The dinner preceding the meeting will be served at 7:00 P. M. Reservations should be made with Mr. Irving Hochstadter.

ACCORDING to a special dispatch to the *New York Times*, from Ithaca, New York, dated October 15, element No. 87, one of the two hitherto unknown components of the universe, has been discovered by Dr. Jacob Papish, professor of spectroscopy at Cornell University, in a substance known as samarskite, a lustrous velvet black mineral found in Norway, Siberia and in some southern states of this country. Of the ninety-two elements only No. 85 now remains unidentified. Assisted by Mr. Eugene Wainer, a graduate student from Akron, Ohio, and aided by a grant from the Heckscher Foundation for the Advancement of Research, Professor Papish has definitely identified the new element and has secured a spectrogram of it Repeated checks have confirmed its existence and a full report is expected to be made to the National Academy of Sciences when it meets in New Haven next month.

Nature prints the following radiogram, dated Sept 28 "Experimental demonstration of spin of light—The depolarization of Rayleigh scattering of monochromatic light in carbon dioxide gas does not diminish to one quarter of its value when spectroscopically separated from rotational scattering, as demanded by existing theories of radiation The actual observed diminution, from 10 per cent to 6 per cent, is quantitatively explicable, assuming that common light consists of spinning quanta possessing one Planck unit of angular momentum.—C V Raman and S Bhagavantam"

A GROUP of psychologists and economists, headed by Dr Nicholas Murray Butler, president of Columbia University, and Dr James Rowland Angell, president of Yale University, will take part in weekly academic lectures to be broadcast by the National Advisory Council on Radio in Education These broadcasts on present-day economics and psychology were started on October 17 over the network of WEAF Thirty leaders in their respective fields of economics and psychology will speak An economist and a psychologist will speak fifteen minutes, respectively, in each program The broadcast will be on Saturday nights from 8 30 to 9 o'clock. Dr Butler opened the series on October 17 He was followed by Dr Angell, who discussed "Psychology To-day, its Relations to Other Sciences and Social Problems" Dr Ernest L Bogart, president of the American Economic Association, will open the radio course in economics with an address on "Forerunners of the Present Depression" There will be thirty lectures in each series The first ten addresses in the economics series will deal with the causes and solution of the economic depression Others who will lecture later are Miss Jane Addams, of Hull House; Dr Edwin F Gay, professor of economic history, Harvard, Dr Walter R. Miles, president of the American Psychological Association, Dr Edward S. Robinson, professor of psychology, Yale University; Dr. Robert S Woodworth, president of the Social Science Research Council, and Dr. Arnold Gesell, director of the Clinic on Child Development, Yale University

A NEW school of archeology and museum has been established at Las Vegas under the supervision and control of the New Mexico Normal University Mr J. I. McCullough, teacher of history of the Southwest courses at the Normal University during the past year, has been appointed director and organizer of the school.

THE College of Medicine of the University of Illinois opened on October 5. All departments are now housed in the new buildings These buildings will accommodate 200 students in each class The laboratories are contiguous with the Research and Educational Hospital which has a capacity of 500 beds Three hundred and sixty of these beds are occupied at the present time and are used exclusively for research and teaching purposes In addition to the Research and Educational Hospital, the large State Department for Juvenile Research is closely affiliated with the College of Medicine and offers a wealth of material of border-line and subnormal cases which are of great value in psychological and neurological studies. A Psychiatric Institute with 62 beds and an Orthopedic Institute for Children with 100 beds have also been opened It has been necessary to limit the number of dispensary patients to 100,000 per year The library and reading rooms have been enlarged to keep pace with the growth of the college Reading rooms have a seating capacity of 500 The library has over 40,000 volumes which includes complete files of practically all clinical and biological research journals.

THE construction of the largest and most complete establishment in the world devoted to research on wood has been started by the U S Department of Agriculture in the form of a new fireproof building for the Forest Products Laboratory at Madison, Wisconsin, the contract for which is the principal award under a $900,000 Congressional appropriation to provide the laboratory with adequate quarters and equipment Better utilization of forest materials and broader markets for forest products are the objectives for which government research workers will use the new facilities In its six stories, with total floor space of 175,000 square feet, the building will contain modern technical and scientific facilities for testing and investigating wood and other forest products in manifold uses and transformations, from logs, poles and lumber to pulp, paper and turpentine

BERNARR MACFADDEN, publisher and physical culture and health propagandist, has donated $5,000,000 to form the Bernarr MacFadden Foundation, a charitable corporation for the perpetuation of physical culture and health building. The $5,000,000 and the income from it will be spent, according to the certificate of incorporation, to maintain and conduct institutions, establish scholarships, maintain sanitariums, gymnasiums, camps and other recreational facilities, and to promote hygiene and health and the physical well-being of young men and women The work of the foundation, the certificate says, is to be conducted principally in the United States, "but is not restricted thereto"

The London *Times* reports that Professor Maiuri, superintendent of excavations in the Campania, has been granted funds from the British Government for carrying out excavations on the island of Capri He proposes to reveal and display, so far as possible, the ancient topography of the island, as it was in the Roman era The many Roman buildings which lie buried and have only been partially excavated so far are to be laid bare, the roads of access to them are to be made more practicable, and a general work of embellishment undertaken so that the ruins may be presented in a setting worthy of their past glory In the days of the Emperor Tiberius there were twelve palaces in the island, named after twelve gods, and the emperor is supposed to have lived in a different one during each month of the year The most important of these is the Villa Jovis, which lies at the extreme eastern point of the island overlooking the Sorrentine Peninsula. It is built on a peak, and from the cliffs on which it stands there is a sheer drop of about 700 feet to the sea It is on the ruins of this palace that Professor Maiuri began work early in October

The U S Bureau of Fisheries is making a study of fish migration in the waters of the Chesapeake Bay Dr John C Pearson, assistant aquatic biologist, who has been stationed at Annapolis for the purpose of clamping identification bands on any fish which he can obtain for labeling and liberation purposes, tagged a rockfish and released it off Hackett Point, Annapolis Two days later the same fish was caught about thirty miles up the bay, near the mouth of the Seneca River Other fish bearing the identification tags have been caught in the vicinity of Havre de Grace and the Northeast River Thus far the results of the study show a tendency of the fish to make for the head of the bay

The Chilean Nitrate of Soda Educational Bureau has again made provision for the Chilean Nitrate of Soda Nitrogen Research Award These awards were designed to foster search on the rôle of nitrogen in economic crop production Any research worker in the United States or Canada is eligible In selecting candidates for the award attention is given to both the merits of research already accomplished and to the promise for future work The award is administered by the nitrogen research award committee of the American Society of Agronomy The amount of the award is decided by the committee in each individual case Any one wishing to call the attention of the committee to their own work or that of any other worker should communicate before November 1 with the chairman of the committee, Dr Richard Bradfield, Department of Soils, Ohio State University, Columbus, Ohio The award will be made at the annual meeting of the American Society of Agronomy in Chicago, on November 19 and 20

DISCUSSION

ON A POSSIBLE EXPLANATION OF THE DIFFERENCE IN WAVE-LENGTHS OF THE SPECTRAL LINES OF A GIVEN ELEMENT PRODUCED ON THE SUN AND ON THE EARTH

It has been shown that all electric charges on the earth are due to a potential difference between an insulated body and the electrostatic field in which it is immersed[1] When this potential difference changes, the magnitude or the sign, or both, of the charge on the insulated body changes It is immaterial and sometimes not discoverable whether the change in potential difference is due to a change in the electron content of the insulated body or to a change in the electrical state of the surrounding field

Since the potential of the earth's electrostatic field changes with a change of altitude above the earth, the charge of an insulated body will change as its altitude in the earth's electrostatic field changes This fact was discovered by Paul Erman in 1803,[2] though it was not interpreted in this manner Erman believed the charges upon his electroscope to be induced by the charge of the earth, but we know that no insulated body can have a charge induced upon it The most that can happen to it by induction is to have a redistribution of its charge over its surface

An uncharged, insulated body when raised above the earth acquires a negative charge If retained in that position and put into electrical contact with the earth it loses its negative charge If then lowered to the earth it acquires a positive charge. If raised to a greater height than before without discharging its positive charge it again becomes negatively charged.

If two small insulated spheres be charged, one positive and one negative, to a potential difference from the earth of 100 volts each, they will then attract each other with a force proportional to the product of their opposite charges Let them be raised to a height where the potential of the earth's field is 100 volts positive to the earth One of the spheres will then be charged to a negative potential of 200 volts and the other will be uncharged. There will be no attraction due to the product of their charges.

---

[1] *Bulletin* of the Terrestrial Electric Observatory of Fernando Sanford, Vol 6, p 8, and "Terrestrial Electricity," p 100

[2] *Gilbert's Annalen*, 15, 386 (803).

Let them now be raised to a height where the potential of the earth's field is 200 volts positive. One sphere will now be charged negative to a potential of 300 volts, and the other will be negatively charged to a potential of 100 volts. They will now repel each other with a force proportional to the product of their like charges. This was virtually Erman's fundamental experiment.

Suppose a negatively charged particle to be in orbital revolution about a positively charged particle near the surface of the earth. Other conditions remaining unchanged, the frequency of revolution will change with every change of the product of their opposite charges. The same will be true for other forms of oscillation of the two particles, hence any change in their altitude above the earth will cause a change in their vibration frequency.

If the same laws apply within the atom, the wave-lengths of its spectral lines will vary with a change of potential of the electrostatic field in which it is placed. Thus, if the electrostatic field of the sun is different from that of the earth, the wave-lengths of the spectral lines in the sun's electric field will be different from those of the same kind of atom in the earth's field. We know that they are appreciably different.

We believe that the Fraunhofer lines in the solar spectrum are due to the absorption of gases at different elevations above the photosphere. Accordingly, these gases are differently charged. May not the broadening of some of the absorption lines be partly due to this cause?

FERNANDO SANFORD

PALO ALTO, CALIFORNIA

BOTTOM TEMPERATURES IN DEEP LAKES[1]

ALMOST without exception, published accounts of temperature cycles in lakes fail to mention the effect of pressure on the temperature of water at maximum density. That increased pressure lowers the point of maximum density has been known to physicists for half a century. Results obtained by various workers are not in complete agreement. According to Amagat[2] the lowering effect is in the neighborhood of 0.0235° C. per atmosphere, although the relationship is probably not strictly linear. Since a depth of 10.33 meters corresponds roughly to one atmosphere of pressure, it follows that deep lakes may have bottom temperatures below 4.0° C. in summer. A number of such observations have been made in this country and many more have been made elsewhere.

The first observations in North American lakes which have come to the attention of the writer were made in Lake Superior during August, 1871.[3] Most of the bottom readings were 3.8° or 3.9°, two very low readings were obviously erroneous. Yoshimura,[4] in a recent review of this subject, reported a temperature of 3.7° at 300 m for Lake Ontario in the same year, but the source of the data is not evident. Drummond[5] reported temperatures in Georgian Bay in 1886 which were well below the minima possible according to the calculations of Amagat. In the summer of 1889 he found 3.7° at 128 m and 3.9° at 115 m on different days and at different stations. In 1911 Hamberg,[6] noting similar records from European lakes, pointed out that they could be explained by the effect of pressure on the temperature at maximum density.

In Crater Lake, Kemmerer et al.[7] found 3.5° at 600 m, and all temperatures at 100 m or deeper were less than 4.0°. Kindle[8] reported 3.3° at 96 m and 1.1° at 130 m in Lake Ontario in late September. These readings are so low that they must be regarded as errors, and they cast doubt upon the accuracy of a reading of 3.9° at 121 m at another station.

During the summer of 1930 a large number of temperature observations were made from the Bureau of Fisheries vessel *Fulmar* in Lake Michigan. Of 26 readings in water over 100 m deep, nine gave 3.9°, one gave 3.8°, and the others were 4.0° or more. One station showed 3.9° water from a depth of 75 m to the bottom at 145 m. The greatest depth at which observations were made was 168 m and lower temperatures may be expected in the deepest part of the lake (264 m).

Summer temperatures below 4.0° have not been reported for Lake Erie or for Lake Nipigon. The same is true of Lake Tahoe,[8] with a depth of 501 m. Obviously very deep lakes can have bottom temperatures well above the minima possible under pressures corresponding to their depths.

While the number of lakes showing bottom temperatures below 4.0° in summer is not large and the lower temperatures probably have little biological significance, the phenomenon is worthy of mention, even in elementary texts. Ignorance of it may lead an inexperienced observer to question the accuracy of his thermometers.

STILLMAN WRIGHT

U. S. BUREAU OF FISHERIES,
ANN ARBOR, MICHIGAN

---

[1] Published by permission of the U. S. Commissioner of Fisheries.

[2] E. H. Amagat, *Ann. Chim. et Phys.*, (6), 29: 570, 1893.

[3] W. R. Nichols, Proc. Bost. Soc. Nat. Hist., 21: 53, 1880–1882 (1883).

[4] S. Yoshimura, Umi to Sora, 10 (12): 423, Kobe, 1930.

[5] A. T. Drummond, Can. Rec. Sci., 4: 77, 1890.

[6] A. Hamberg, Pet. Geogr. Mitteil., 57 (12): 306, 1911.

[7] G. Kemmerer, J. F. Bovard, and W. R. Boorman, Bull. Bur. Fish., 39: 51, 1923.

[8] E. M. Kindle, Trans. Roy. Soc. Can., 19: 47, 1925.

METABOLISM OF CYSTINE AND METHIONINE

The fact that methionine is similar to the indispensable amino acid, cystine, in containing sulfur lends considerable interest to the fate of methionine in the animal organism as well as to any possible metabolic interrelation of these two protein units We have investigated the effect of the administration of racemic methionine to albino rats ingesting food presumably deficient in cystine The basal diet contained whole milk powder at a low level with a supplement of gelatin It was found that, whereas the administration of other amino acids, serine and alanine, as well as certain derivatives closely related to cystine, produce a negligible or at most a very minor acceleration in growth, the addition of either cystine *or methionine* to the diet produces an *unmistakable* increase in body weight The conclusion that methionine may satisfy an animal's cystine requirement might be drawn from these experiments However, we prefer at this time to postpone final interpretation of the findings until we have carried out further experiments to throw more light upon the phenomenon in question

Richard W Jackson
Richard J Block
Laboratory of Physiological Chemistry,
Yale University

THE TRANSFORMATION OF CAROTENE TO VITAMIN A IN VITRO

Moore[1] and Capper[2] have been able to demonstrate the transformation of carotene to vitamin A in rats More recently, the conversion has been observed in the fowl[3] *If the reaction is enzymatic, it should be possible to transform carotene to vitamin A in vitro*

Preliminary experiments indicated that carotene was destroyed and that vitamin A appeared when carotene was incubated with fresh liver tissue, obtained from vitamin A-deficient rats Ultra-violet absorption spectra of the ether extracts of such mixtures showed a band at 325 μμ, characteristic of vitamin A, while the ether extracts of the livers without carotene addition were without absorption at that wave-length.

The following experiments verified the supposition that an enzyme was responsible for the reaction. Two rats which had ceased to grow on a vitamin A-free ration were killed, their livers extirpated, and ground with sand and water After standing for 24 hours at 37°, the extract was filtered. One portion of the liver extract was extracted with ether An ultra-violet absorption spectra photograph of the extracted material showed no absorption at 325 μμ, indicating that the liver extract contained no vitamin A

Another portion of the liver extract was added to a few cubic centimeters of a colloidal solution of carotene in water, the mixture was incubated for 36 hours and extracted with ether The ether extract was colorless, there was a definite band at 325 μμ, and none at 340 μμ, at which wave-length carotene itself absorbs. A third portion of the liver extract was boiled for one minute, then treated with carotene as before After incubation, the ether extract was yellow, the absorption spectrum showed no band at 325 μμ, while the band at 340 μμ was still present. The enzyme, which should be called "carotenase," had been destroyed by the heating

Harold S Olcott
Duane C McCann
Laboratories of Biochemistry and Analytical Chemistry,
State University of Iowa

CONICAL SNOWFLAKES

The account by Professor A D Moore, in Science for June 12, of the fall of conical snowflakes at Ann Arbor recalled similar conical flakes or stones which I observed at what was then the Great Basin Forest Experiment Station above Ephraim, Utah, in September, 1920 The station is situated on a small bench at 8,750 feet elevation in the Wasatch Mountains and during the latter part of the summer is subject to short but intense rain or hail squalls On one occasion, however, the precipitation, instead of being in the usual form of rain or round hail, consisted of cones of hard compacted snow The bases of the cones were hemispherical, giving the stones the general outline of an inverted parachute In size they ranged larger than those observed by Professor Moore, all being over one quarter inch across the base and many of them reaching one half inch The fall was accompanied by a strong wind from the northeast and lasted only a few minutes.

I took no notes on the phenomenon at the time and can no longer remember just what the weather was, preceding the fall, but I recollect that the wind which accompanied the squall was cold. The stones were so dense and landed with such force that we were compelled to take shelter, but in composition they were packed snow and not the ice of ordinary hailstones.

Willis W. Wagener
U S. Department of Agriculture,
Bureau of Plant Industry,
San Francisco, Calif.

---

[1] T. Moore, *Biochem. Journ.*, 1930, 24, 692, 1931, 25, 275.

[2] N S Capper, *Biochem Journ.*, 1930, 24, 980

[3] N S Capper, I M W McKibbin, and J. H. Prentice, *Biochem. Journ.*, 1931, 25, 265.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE HOST INSTITUTION AND HOTEL HEADQUARTERS FOR THE NEW ORLEANS MEETING

Twenty-six scientific societies have signified their intentions of meeting with the American Association for the Advancement of Science at its New Orleans meeting, from December 28, 1931, to January 2, 1932 This meeting, the eighty-ninth of the American Association, will be held under the presidency of Dr Franz Boas, of Columbia University Tulane University will be the host institution Professor D S Elliott, the chairman of the local committee for the New Orleans meeting, has supplied the following information regarding the host institution

The Tulane University of Louisiana was organized as the Medical College of Louisiana in 1834 In 1845, the state constitution established the University of Louisiana with the departments of law, medicine and natural sciences and letters In 1882, Mr Paul Tulane, of Princeton, New Jersey, formerly a resident of New Orleans, donated his property in New Orleans for educational purposes to a board of administrators who organized themselves as the Tulane Education Fund This donation, with subsequent gifts, amounted to $1,050,000 In 1884, by an act of the legislature of Louisiana of that year, the existing University of Louisiana was transferred to this board and the name was changed to The Tulane University of Louisiana. In 1886, Mrs Josephine Louise Newcomb donated $100,000 to establish the H Sophie Newcomb Memorial College as the women's department in the university She added largely to her original endowment, and by her will bequeathed about $2,700,000 additional

The university comprises the following departments: The College of Arts and Sciences, the College of Engineering, the H Sophie Newcomb Memorial College for Young Women, the Graduate School, the College of Law, the College of Medicine (including the Schools of Medicine and Pharmacy, the Graduate School of Medicine, and the Dental Clinic), the College of Commerce and Business Administration, the Courses for Teachers, the School of Social Work, the Department of Middle American Research, and the summer schools The College of Engineering includes courses in mechanical and electrical engineering, civil engineering, chemical engineering and architecture Newcomb College includes, in addition to the usual college courses, the Schools of Art and Music.

The campus of ninety-two acres, with its imposing buildings, faces Audubon Park, one of the most beautiful parks in the South There are thirty-one buildings, many of which have been erected in recent years. Among these are Gibson Hall, the Physics Building, the Richardson Chemistry Building, the Science Building and Annex, Stanley Thomas Hall and the Old Engineering Building, the Richardson Memorial Medical Building, the Tilton Memorial Library, the Dining Hall, the Academic Dormitory, the Richardson Memorial Medical Dormitory and the Gymnasium The following buildings of the H Sophie Newcomb College for Women are on that part of the campus facing Broadway Administration Building, Art Building, Swimming Pool and Gymnasium, and Nos 29, 43 and 57 Newcomb Campus and the following dormitories for women The Josephine Louise House, Doris Hall and the Warren Newcomb House Dixon Hall, one of the newer buildings, provides a fine auditorium seating about one thousand persons, class, office and practice rooms for the Newcomb School of Music, and in a wing a library, reading room and stack room.

The third and fourth year medical students, as well as the students of graduate medicine, are taught in the new Hutchinson Memorial Building on Tulane Avenue, which is opposite the great Charity Hospital, the unrivaled facilities of which are used in their instruction This building, which cost with equipment approximately $1,250,000 provides the necessary classrooms and laboratories and furnishes a better distribution of space than the old building on Canal Street, as well as more adequate equipment for this work. The new building, however, is intended to do much more than this In it will be operated out-patient clinics for the various medical branches These clinics will be arranged and conducted for the purpose of teaching medical students the practical treatment of patients in preparation for their future work. The building has been erected on the property purchased by the university in the square adjacent to the Charity Hospital on Tulane Avenue. The building provides suitable quarters for the Graduate School of Medicine, the Dental Clinic and the Orleans Parish Medical Society.

The College of Commerce and Business Administration holds its day and night courses in Gibson Hall The other departments of the university consisting of the Colleges of Arts and Sciences and Engineering, the Graduate School, the College of Law, the first and second years of the School of Medicine and the classes of the School of Pharmacy are conducted in the buildings located on the campus on St. Charles Avenue, opposite Audubon Park, in the city's handsomest residential district, with the exception of the Newcomb College buildings.

The dormitories for students of Newcomb College for Women are located on that part of the campus of the university occupied by the Newcomb College buildings, facing Broadway The Josephine Louise House, known as The Residence, on the corner of Broadway and Plum Streets, has accommodation for about 190 students, together with the refectory and a special lunch room in the basement for day students The building is modern in every respect and fireproof Doris Hall is located at the corner of Newcomb Campus and Willow Street It was opened for occupancy at the beginning of the session 1925–26 It is a thoroughly commodious and well-equipped brick and stone building of two stories and a basement It houses twenty-five students of moderate means who are willing to help reduce the cost of their college education by cooperative effort The Warren Newcomb House, accommodating fifty-two students, was occupied with the beginning of the session 1928–29 It is a two-story and basement structure of reinforced concrete and brick, located on Newcomb Campus next to Doris Hall

The American Mathematical Society and the Mathematical Association of America will have their headquarters at the Sophie Newcomb dormitories Other societies' headquarters will be located in the hotels, some of which are world-renowned Society hotel assignments, together with information concerning the hotels, are as follows

Roosevelt University Place, near Canal Street All rooms with bath Single rooms, \$4.00 to \$6 00 per day; double rooms, \$6 00 to \$9 00 per day

General headquarters for the association
American Physical Society
American Society of Zoologists
American Society of Parasitologists
Society of Petroleum Geophysicists.
Econometric Society.
Metric Association

St. Charles St Charles Ave, Common and Gravier Streets. Single rooms, \$2 00 and \$2 50 per day, (with bath) \$3 00 to \$5 00 per day, double rooms, \$3 50 to \$4.00 per day, (with bath) \$5 00 to \$7 00 per day

Botanical Society of America
American Phytopathological Society
American Society of Plant Physiologists.
American Society of Naturalists
American Society for Horticultural Science
American Microscopical Society
Ecological Society of America.

Marbero Canal and Loyola Streets. All rooms with bath. Single rooms, \$3 00 to \$3 50; double rooms, \$4.00 to \$6.00 per day

Entomological Society of America.
American Association of Economic Entomologists.
American Nature-Study Society.

Jung · 1500 Canal Street. All rooms with bath. Single rooms, \$3.50 per day, double rooms, \$5 00 to \$6 00 per day.

American Society of Agronomy.
Society of American Foresters

De Soto Baronne and Perdido Streets Single rooms, \$2 00 per day, (with bath) \$2 50 to \$3 00 per day, double rooms, \$3 00 to \$4 00 per day; (with bath) \$3 50 to \$5 00 per day.

American Meteorological Society
Potato Association of America
Wilson Ornithological Club.

Monteleone Royale and Iberville Streets Single rooms, \$2 00 per day; (with bath) \$3.00 to \$3 50 per day; double rooms, \$3 00 to \$3 50 per day, (with bath) \$5 00 to \$6 00 per day

Southern Society for Philosophy and Psychology

La Salle · N Rampart and Canal Streets Single rooms, \$2 00 per day, (with bath) \$3 00 per day, double rooms (with bath) \$4 00 to \$5 00 per day

Phi Sigma Biological Research Society

Bienville St Charles Avenue, at Lee Circle. All rooms with bath Single rooms, \$3 00 to \$3 50 per day, double rooms, \$4 50 to \$6 00 per day

Honor Society of Phi Kappa Phi

Chalmette 808 Carondolet Street Single rooms, \$1 50 to \$2.50; (with bath) \$2 00 to \$2 50; double rooms (with bath), \$3 00 to \$4 00.

Ponchartrain Apt Hotel. 2031 Charles Street. All rooms with bath. Single rooms, \$3 00 up, double rooms, \$5.00 up; suites, \$10.00 up.

All the above hotels are very centrally located and within convenient walking distance from any one to the others and to the Municipal Auditorium, where many of the general sessions will be held All are convenient to direct transportation lines to Tulane University

We are assured that a sufficient number of rooms will be reserved by these hotels to accommodate those who will attend the New Orleans meeting, but in order to save possible disappointment members are urged to make their reservations at once. These should be sent directly to the hotel selected.

Further information regarding the New Orleans meeting will be given from time to time in short announcements in SCIENCE and in the special issue of SCIENCE containing the regular preliminary announcement. This latter will appear during the last of November.

CHARLES F. ROOS,
Permanent Secretary

SECTION F (ZOOLOGY) AT NEW ORLEANS

AT the New Orleans meeting, section F of the American Association for the Advancement of Science and the American Society of Zoologists will hold sessions for the reading of papers on Tuesday, Wednesday and Thursday, December 29, 30 and 31. Following the policy of recent years the program will be arranged with formal reading of papers in morning sessions and informal demonstration presentation in afternoon sessions Those who expect to contribute should indicate which type of presentation they prefer All contributed papers will appear in the program of the American Society of Zoologists, Section F holding no separate sessions for the reading of papers The address of the vice-president of the section, Dr. Robert W Hegner, entitled, "How the Other Half Live," will be given immediately following the annual zoologists' dinner on Wednesday evening.

The business session will come on Wednesday afternoon at 2 o'clock, immediately preceding the business session of the society Hotel headquarters for both groups will be the Roosevelt Hotel All rooms have baths and range upward from $4 for single rooms and $6 for double rooms. Reservations for hotel accommodations should be made early by members, directly with the hotel and not through secretaries or local committee. Other hotels are available, a list of which will be given in an early issue of SCIENCE, in the preliminary announcement of the American Association for the Advancement of Science Arrangements have been made for the usual railroad rates of a fare and a half on the certificate plan and will be specially announced in the preliminary announcement of the permanent secretary of the association In securing transportation buy a first-class, one-way ticket, and obtain for each ticket a certificate for the "New Orleans Convention of the American Association for the Advancement of Science and Associated Societies" Present this certificate at the registration offices in the Venetian Room of the Roosevelt Hotel immediately upon arrival, and call for it at the same place the next day; a half-fare returning ticket may be procured after obtaining this validated certificate. A registration fee of $1.00 for members of the association and $2.00 for others will be charged Return Pullman reservations on trains should be arranged for shortly after arrival.

Members of Section F who desire to present papers should send the exact title and an abstract of not more than 250 words to reach the secretary not later than November 1; titles received later than this can not be placed on the program and titles without abstracts will not be considered or accepted. Indicate in what group (cytology, embryology, parasitology, protozoology, comparative anatomy, general physiology, etc.) the paper is to be read and whether charts or lantern slides will be used. The rules of the American Society of Zoology are followed in arranging the program and conducting the sessions; members are limited to a total time of fifteen minutes, whether for one or several papers, and the time of a person introduced by a member is included within the fifteen-minute limit.

The titles and abstracts should be sent as early as possible, preferably to the secretary of the American Society of Zoologists (Dr William H Cole, Rutgers University, New Brunswick, N J) or to the secretary of the section.

GEO T. HARGITT

DUKE UNIVERSITY,
DURHAM, N C

SECTION E (GEOLOGY AND GEOGRAPHY)

SECTION E (Geology and Geography) of the American Association for the Advancement of Science will meet in New Orleans on Friday, January 1, for its annual session. The chairman for the meeting is Professor Douglas W Johnson, of Columbia University, who will deliver his address as retiring vice-president that afternoon, and the secretary is Professor Kirtley F. Mather, of Harvard University A regional committee under the chairmanship of Professor R A Steinmayer, of Tulane University, has been organized, and a symposium on the "Geology of the Gulf Coastal Prairies" is planned for the afternoon meeting The annual dinner for geologists and geographers will be held on Friday evening Titles and abstracts of papers for the symposium should be submitted to Professor Steinmayer prior to November 10, titles and abstracts of other papers for this meeting should be submitted to Professor Mather prior to November 15.

Saturday, January 2, will be devoted to a field trip to the salt domes and mines of the Teche country. Those taking the trip will board a Pullman in New Orleans, after the dinner on Friday evening, for New Iberia, Louisiana, and may return to New Orleans on Saturday evening. Those interested in the field trip should communicate directly with Professor Steinmayer at the earliest opportunity

It is probable that Section E will join with the members of the American Physical Society and other organizations in a joint session for the presentation of papers dealing with geophysics on Wednesday, December 30. If so, arrangements will be made for short field excursions on Thursday, December 31.

Arrangements have been made for special diverse route fares on the round trip identification plan, which will make it possible for geologists to purchase tickets at reduced rates from their homes direct to Tulsa, Oklahoma, for the meeting of the Geological Society of America and the American Association of Petroleum Geologists at that place from December 28 to 31 and return via New Orleans, stopping there for the meetings of Section E on January 1 and 2.

KIRTLEY F. MATHER,
Secretary

HARVARD UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR DETERMINING THE PURITY OF LIMESTONE IN THE FIELD

The wide distribution of lime deposits, the variability in the carbonate content of the deposits, and the wide-spread use of portable grinding equipment makes the perfection of an accurate field test, whereby the purity of the stone may be determined, highly desirable McHargue[1] and Hopkins[2] have devised an apparatus for measuring the amount of carbon dioxide produced by treating the lime with an acid The amount of apparatus required and the difficulties encountered in calculating the results have tended to limit the application of the method

The author has devised an apparatus which will accomplish the same result, with the same degree of accuracy and within a period of ten minutes. The entire apparatus may be carried in a small kit weighing approximately eight pounds The essential features of the apparatus are

(1) A 25 x 250 mm Pyrex tube, graduated in such a manner that, by the use of standardized acids and alkalies, the percentage of lime (as pure $CaCO_3$) in the sample may be read directly

(2) A standardized acid containing an indicator, and a standardized alkali of such strength as to correspond with the volumes indicated by the graduation on the tube

(3) A modified hydrometer equipped with a removable pan on the tip, and so constructed as to float free in the graduated tube yet will be capable of weighing one gram of limestone with an accuracy of ± 2 per cent.

The sample is weighed by dropping it on the pan of the floating hydrometer until the proper point is reached The tube is emptied and a definite quantity of acid added The sample is then added and, after the violence of the reaction has subsided, the height of the liquid is adjusted to a definite volume The contents are then boiled for five minutes over an alcohol flame The volume is again adjusted and sufficient alkali added to produce the neutral point The graduation at the height of the total volume shows the percentage of lime A detailed explanation of the apparatus will appear later

Paul Emerson

Soils Department,
Iowa State College

A SIMPLE, QUICK AND INEXPENSIVE METHOD OF PREPARING LANTERN SLIDES

The advantages of a quick method for preparing lantern slides which may be simply done and without the usual cost are especially valuable in the case of taking diagrams from a text or journal, or for producing necessary slides on short notice

I have found the following preparation to have the above qualifications and to be very effective Take a plain glass lantern slide, thoroughly clean it and allow to dry When the slide has become quite dry apply a thin coat of albumin from a fresh egg and again allow the slide to dry A smooth brush is essential in getting the coat of albumin evenly placed to avoid a streaked appearance when done

As soon as the albumin has completely dried, place the plate with its coated side uppermost, over the diagram or other copy, and trace on the slide with India ink The width of the lines may be varied by using pens of different sizes Colored effects may be added in the same manner except that inks made from aniline dyes (such as the common writing fluids) should be used The pigmentation in colored India inks make them all appear black on the screen

Mount in the usual manner after the ink has dried by placing the newly made plate face down on another clean slide and fastening together with the usual lantern slide material or with adhesive tape

These slides are not temporary as might be supposed but may be left in the lantern for long periods of time without injury in spite of the intense heat of some lanterns I have used this preparation for the past five years and it is now being used by others in this department

P E. Reid

Department of Physiology
and Pharmacology,
Northwestern University
Medical School

SPECIAL ARTICLES

A NATURAL COPPER DEFICIENCY IN CATTLE RATIONS

A preliminary report was made at the recent meeting of the American Dairy Science Association in Davis, California, of a naturally occurring nutritional anemia of cattle in Florida. This anemia is caused by a deficiency of iron, or of iron and *copper* in the native vegetation growing on white or gray sand,

---

[1] J S McHargue, "County Agents' Calcimeter," Kentucky Agric Expt Sta Circ. 9, 1915

[2] C. G. Hopkins, "A Limestone Tester," Illinois Agric. Expt. Sta. Circ. 185, 1916.

Everglades muck, or Homestead marl soils. It does not occur on clay soils or on soils subject to overflow from clay lands So far as known, this is the first natural copper deficiency reported

Yearlings and heifers suckling first calves are most affected, although all ages suffer It has been observed in sheep, goats and swine Growth is retarded as much as one half Reproduction is greatly impaired This condition, known locally as "Salt Sick," has always been the cause of much loss to Florida's cattle industry On some areas it has been impossible to keep cattle for any length of time

Affected animals exhibit almost complete loss of appetite, emaciation, weakness and pale mucous membranes Clay, sand, rags or dry weeds may be eaten when all feed is refused Constipation and diarrhea in advanced cases are observed The mortality rate has been high where cattle were not moved to healthy range or fed grain from an unaffected area

Early workers at the Florida Agricultural Experiment Station described the post-mortem findings as identical with those of chronic tick fever (with which Salt Sick has been confused), except for the spleen The spleen parenchyma is atrophied, the entire organ being about one quarter of its normal size The hemoglobin of the blood often falls below four grams per cent, and the blood volume is reduced All tissues are pale The heart muscle is flabby and lacks tone Otherwise the findings are those of extreme inanition

Several hundred cases have been treated in the field Three fluid ounces of a six per cent. solution of ferric ammonium citrate fortified with copper sulfate in molecular ratio of 50 1 given daily as a drench has been effective even in advanced cases Two ounce doses are given to smaller animals For prevention of the trouble and cure of less advanced cases, a lick made of 100 pounds of salt, 25 pounds of ferric oxide and one pound of copper sulfate given *ad libitum* has been found to be satisfactory.

Some hemoglobin determinations made in the field by means of a standardized Dare hemoglobinometer during the field work are as follows

15	critical cases of salt sick	39 5 per cent
87	visibly affected cases	60 8 " "
87	cases after one month treatment	77 2 " "
84	healthy animals in same herds	100 9 " "
185	healthy animals in unaffected areas	93 1 " "

Controlled feeding trials now in progress completely confirm the results of the field work. Iron supplements alone, even with the amount of copper present in technical chemicals, have proven inadequate. This may indicate a relatively high copper requirement in the bovine. Chemical and histological studies of all cases developed are being made. Tabulation of iron analyses of forage samples confirm the deficiency of iron, and copper analyses are being prosecuted.

W M. NEAL
R B BECKER
A L SHEALY

ANIMAL HUSBANDRY DEPARTMENT,
FLORIDA AGRICULTURAL EXPERIMENT
STATION

DECREASE IN RATE OF OXYGEN CONSUMPTION UNDER THE INFLUENCE OF VISIBLE LIGHT ON SARCINA LUTEA

FOR these experiments cultures of the micrococcus *S lutea* were grown for twenty-four hours on 1 per cent peptone agar The organisms were then gently washed from the medium with distilled water, centrifuged rapidly, washed again and finally suspended in such a quantity of distilled water that there were approximately 5×10^8 cells in each cubic centimeter Of this suspension, one cubic centimeter was pipetted into each of four reaction vessels of Warburg manometers,[1] one cubic centimeter was heated to boiling for a minute, made up to volume and pipetted into a fifth reaction vessel, the remainder of the suspension was used to inoculate new cultures and for other purposes The reaction chamber of a sixth manometer contained one cubic centimeter of sterile distilled water These vessels, into the side-arm of which a half cubic centimeter of normal base (NaOH) had been introduced, were then affixed to their respective manometers. The manometers were set in position in the water bath and allowed to shake for half an hour with open stopcocks, until temperature equilibrium. Then the stopcocks were shut, and since the base absorbed all the carbon dioxide excreted, the change in pressure registered by the manometers can be attributed wholly to the consumption of oxygen by the *Sarcina* in the closed system. The water bath was thermostatically controlled so that the temperature did not vary more than ± 0 02° C., during the course of any experiment Illumination was provided by 10 60-w frosted Mazda lamps arranged in two rows below the water bath, the light passing through the plate glass bottom of the tank and then nine inches of water before impinging on the reaction vessel. The two vessels in which we measured the oxygen consumption in the dark were wrapped in tin foil The intensity of illumination was frequently controlled and found to be 556 ± 8 meter candles at the level of the vessels.

---

[1] O. Warburg, "Über d. Stoffwechsel d. Tumoren," 1926.

Fig. 1 shows a pair of curves drawn through the plotted data of four pairs of series, each plotted point representing the arithmetic mean of twenty observations In from 48 to 72 hours, the oxygen consumption falls off to practically nil, while the total quantity of oxygen consumed is approximately equal in the irradiated series and in the dark controls. At the end of a run, the *Sarcina* were plated out to make a count of viable organisms, the results of the counts indicate either that there had occurred no appreciable number of deaths during the period, or that the number of deaths was compensated by the appearance of an almost equal number of new organisms.

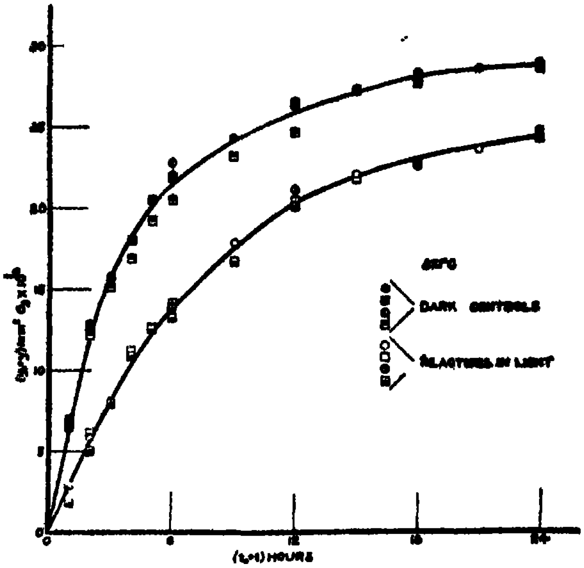


FIG 1 Curves plotted to data from four series of experiments in distilled water and inorganic salts Each point represents the arithmetic mean of twenty determinations t_0 is the time elapsed between the beginning of starvation and the beginning of measurement, similarly, y_0 is the oxygen consumption during the period t_0 Both t_0 and y_0 are presented as unknown.

The gradual falling off in the rate of oxygen consumption is of interest, especially since we could attribute it neither to a limitation of oxygen supply nor to an accumulation of metabolites in the suspension medium Apparently, the only substance excreted into the medium by the cells is carbonic acid; since we could find in it no traces even of fatty acids or of nitrogenous compounds And, furthermore, if we added small quantities of fatty acids or alcohols, we found either that they did not affect the rate of oxygen consumption and were left in the suspension medium, or that they materially accelerated the rate of oxygen consumption and were taken up by the cells from the medium.

It may be noted that of the four series of data plotted, one describes the oxygen consumption of *S. lutea* in distilled water, one in phosphate buffer[2] (pH 6.5–8.0), one in half normal sodium chloride solution, and the fourth in tenth per cent. potassium cyanide solution We could as well have plotted the data taken on the oxygen consumption of *S. lutea* in a medium of normal potassium iodide, tenth normal potassium chloride, fiftieth molar ferric chloride, or Ringer solution. The data all lie scattered along the same curves, the effects of the different ions and of the different osmotic pressures being less than the experimental error for any determination, that is, less than 3 per cent. of the mean value of twenty determinations in any other of the suspension media. Similar lack of effect of changing osmotic pressure has been reported by Falk,[3] and is discussed by Beck.[4] Thus, it appears that *S. lutea* is an organism in which the respiration is not responsive to changes in the osmotic pressure of its suspension medium, and furthermore, in which iron catalysis of respiration does not occur[5]—or if it does occur, normally, is not essential for the maintenance of cell oxidations

By inspection, it is evident that even though the total oxygen consumption turns out to be equal in the two series, the rates of oxygen consumption diverge somewhat widely when the cells are irradiated in one case and in the other when they are shielded from light. Indeed, during the first hour, while there is apparently a quantity of light-sensitive material in the cells, the rate for the dark control (at this temperature—37.1° C) may be as much as five times that for the irradiated organisms

I wish to acknowledge the invaluable assistance of Dr R S Lillie and Dr. R W Gerard, of this department.

B. B Rubenstein

Department of Physiology,
University of Chicago

BOOKS RECEIVED

Bridgman, P W. *The Physics of High Pressure.* Pp. vii + 398 87 figures. Macmillan. $5 50

Chemical Catalog Company *Chemical Engineering Catalog, 1931.* Sixteenth edition. Pp. 1017. Illustrated. The Company

Gillespie, Louis J. *Physical Chemistry.* Pp ix + 287. 48 figures. McGraw-Hill $2.75

Hottes, Frederick C. and Theodore H. Frison. *The Plant Lice, or Aphiidae of Illinois.* Pp 121–447. 58 figures. 10 plates. Illinois State Natural History Survey, Urbana.

Levene, P. A. and Lawrence W Bass. *Nucleic Acids.* Pp. 337. Chemical Catalog Company. $4.50.

McAdie, Alexander. *Airgraphics.* Pp. 37. 6 figures. Blue Hill Observatory.

---

[2] M Clark, "The Determination of Hydrogen Ion."

[3] I S Falk, *Abstracts Bact.*, 7: 87–103, 133–147, 1923.

[4] W. A. Beck, *Plant Physiol.*, 3: 413–440, 1928.

[5] O. Warburg, *Biochem. Zeit.*, 136: 266–77, 1923.

SCIENCE

VOL. 74 FRIDAY, OCTOBER 30, 1931 No. 1922

The South's Contribution to Science DR EMMETT B. CARMICHAEL 421

Obituary
Samuel Wesley Stratton DR. F C BROWN. *Recent Deaths* 428

Scientific Events
The New Federal Citrus Fruit Laboratory in Texas, Psychiatric Education, The Ninth International Congress of Pure and Applied Chemistry, The Henry Burchard Fine Hall of Mathematics 431

Scientific Notes and News 433

Discussion
Courses on the History of Physics in American Colleges and Universities PROFESSOR E H JOHNSON *A New Elm Disease* CURTIS MAY *The Gall Bladders of Chicks in a Vitamin D Deficient Condition* · DR. WALTER C RUSSELL and DONALD F CHICHESTER. *A Trematode from the Cloaca of the Gull* RAYMOND M. CABLE and DR. HORACE W STUNKARD *Hybrid Words* DR. G S FRAPS 435

Reports
Gravitational and Electromagnetic Fields 438

Scientific Apparatus and Laboratory Methods ·
Protective Coatings for Mineral and Book Specimens DR. ROBERT W CLARK *A Short Method for the Preparation of Animal Tissues for Staining* · DR. PAUL W BOWMAN and MARK N LINCH 439

Special Articles
Further Experiments on Cortico adrenal Extract Its Efficacy by Mouth PROFESSOR S W BRITTON and H. SILVETTE *Varved Clay in Holmes County, Ohio* · PROFESSOR GEORGE W WHITE 440

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE SOUTH'S CONTRIBUTION TO SCIENCE[1]

By Dr EMMETT B. CARMICHAEL

SCHOOL OF MEDICINE, UNIVERSITY OF ALABAMA

THE general impression has been that most of the scientists of the United States have come from the northern and eastern sections, with the exception of a few, who have come from the western part of the country. On careful investigation, however, it was discovered that a great number of distinguished men of science have come from the South. There are perhaps two main reasons for such an erroneous impression: (1) the after-effects of the Civil War, and (2) the accumulation of the wealth of the nation in the northern and eastern parts of the country Since war has a tendency to suppress the normal development of the conquered land, we might have expected that progress of all sorts, especially scientific progress, would have been delayed. And since many recent scientific achievements have come from institutions which have had the necessary capital for materials and equipment, it would be quite logical to think that the lack of wealth in the South would have had a curbing effect on interest in science. But regardless of the Civil War and this centralization of wealth of the nation, there have been many investigators of the South who have merited national and, in some instances, international recognition.

Since this paper is an attempt to give a brief survey of the whole South's contribution to science, of course, only some of the most important efforts can be included. I shall mention not only contributions made by men who were born and wholly educated in the South, but I shall mention also the scientific labors of those who were born and even educated in the North, but who were undoubtedly strongly influenced through teaching or living in the South.

This study naturally begins with the consideration of that well-known, beloved friend of birds, John J. Audubon, of Louisiana (1780–1851) He painted pictures of birds during his leisure hours and, since he was a poor man, he had to make several business ventures in order to obtain enough money to continue his ornithological work At first, he represented the birds suspended as dead game, but later portrayed them in life-like positions In 1826, he sailed for England and Scotland and during a three-year stay secured enough subscribers to warrant the publication of his work His pictures of the birds were life size and naturally attracted wide attention It took about ten years to engrave and print the "Birds of America" and the "Ornithological Biography," the two works which contain Audubon's chief contributions Audubon was noted for his simplicity, kind-heartedness, love of nature, love of youth and friendliness to humanity In spite of many hardships, poverty and want, Audubon persevered until success crowned his efforts

---

[1] Address of the retiring president of the Alabama Academy of Science, University, Alabama, March 18, 1931.

In the field of botany Alabama has given us an investigator, B M Duggar, who has been actively engaged in teaching and research for thirty-five years During this time he has served two Southern universities and is at present located at the University of Wisconsin He is the author of three works and has reported many articles on research He has been editor of one journal and is assistant editor of another at present Another botanist, W H Brown, of Richmond, Virginia (professor of botany at the University of the Philippines from 1915 to 1924), should be mentioned He was plant physiologist of the Bureau of Science, Manila, from 1911 to 1923, and has been the director since 1924 He is the author of four works and numerous botanical publications Brown has been editor of the *Philippine Journal of* Science since 1924

Zoology, often associated with botany, is a subject that has not been neglected by Southerners W K. Brooks, of Cleveland, Ohio, born 1848 and died 1908, was professor of zoology at Johns Hopkins from 1877 until his death He spent several summers studying the fauna in North Carolina and in Virginia, and was quite influential in the cultivation and development of the oyster industry H H Newman, of Alabama, was professor of zoology and embryology at the University of Texas from 1908 to 1911, and has been professor of the same subjects at the University of Chicago since the latter date He served as dean of the colleges of science at the University of Chicago from 1915 to 1922 He is the author of several works and is especially noted for his investigations on twins and twinning Newman is editor of "The Nature of the World and of Man" Another distinguished zoologist is T. H Morgan, of Kentucky, who directed the work that has led to the discovery of the mechanism of heredity. He has published numerous papers on various phases of heredity. Yet another famous zoologist is R E. Coker, of South Carolina, who received all his training in the South, served in various capacities with the U S Bureau of Fisheries from 1900 to 1922. He has been professor of zoology at the University of North Carolina since 1922 He is the author of various reports and papers relating to barnacles, turtles, oyster culture and mussels.

It was South Carolina that gave us an eminent naturalist, W. Ravenel, who became connected with the U S Fish Commission in 1883, and has served in several responsible posts He has been secretary of the Smithsonian Institution and has served as director of arts and industries in the U S National Museum since 1925

A paper of this kind would not be complete without mentioning Eugene A Smith (1841–1927), of Autauga County, Alabama, who was the second state geologist of Alabama and served from 1873 until his death He was trained as a chemist and, in fact, taught chemistry at the University of Mississippi for three years before coming to the University of Alabama in 1871 as professor of geology and mineralogy. Beginning with the year 1874, he taught chemistry also and continued working with three subjects until 1890 He was made professor emeritus in 1913 and thus was able to devote all his time to the geological survey of Alabama He was responsible for the location of cement and other industrial plants in his state. Smith was an interesting writer, and his bibliography contains over one hundred entries Another geologist, T W Vaughan, of Jonesville, Texas, graduated from Tulane in 1889 He was engaged in geologic and paleontologic researches with the U. S Geological Survey for twenty-nine years He was geologist in charge of coastal plain investigations from 1907 to 1923 and has been senior geologist since 1924. Vaughan has been director of the Scripps Institution of the University of California, La Jolla, California, since 1924 He is the author of several works and has published numerous articles on geology, paleontology, oceanography and recent corals.

The field of chemistry seems to have been quite attractive to the youth of the South, as several distinguished investigators have come from this section. Charles Baskerville (1870–1922), of Noxubee County, Mississippi, was one of those inspired individuals. He received his education from four Southern universities and taught at the University of North Carolina for several years In 1904 he moved to New York; there he became director of the chemical laboratory of the College of the City of New York and held this position until death. His earlier researches were with the rare earths, and he discovered the chemical elements, carolinium and berzelium. Baskerville was a leader in the American Chemical

Society, especially in the New York section. B B. Ross (1864–1930), of Tuskegee, Alabama, is well known to many of us as an inspiring teacher and chemist Ross received his first experience as a teacher at Louisiana State University from 1887 to 1893. He served as state chemist and professor of chemistry thirty-seven years He served Auburn as dean of science for twenty-two years Ross made numerous contributions on the chemistry of sugars and the analysis of fertilizers Another eminent chemist, H C Jones (1865–1916), of New London, Maryland, received his education in the South and taught physical chemistry at Johns Hopkins from 1895 until his death Being an untiring investigator, he published many articles, among which were several on absorption spectra of solutions, viscosity of solvents and conductivity of salts and acids Jones was associate editor of three chemical journals. Ira Remsen (1846–1927), of New York, N Y, became professor of chemistry at Johns Hopkins in 1876, and was director of the chemistry laboratory for thirty-two years He later became president of that institution and served in that capacity for one year, he was made president and professor emeritus in 1913 Remsen had the honor of being president of several scientific bodies, among which was the National Academy of Sciences from 1907 to 1913 After receiving his education in the South, W R Orndorff (1862–1928), of Baltimore, Maryland, became professor of chemistry at Cornell and taught both organic and physiological chemistry at that institution until his death Orndorff contributed numerous articles of original research to several of the chemical journals

There are certain living chemists whom it would be interesting to discuss fully, however, for the purpose of this paper it is sufficient to give only a partial list of their contributions C H. Herty, of Georgia, taught chemistry at his state university and at the University of North Carolina. He is known for his original investigations, especially those on the collection of turpentine and pitch from the pine trees, he is noted, too, for his contributions to the paper industry. He was editor of the *Journal of Industrial and Engineering Chemistry* for several years Herty is a past president of the American Chemical Society. J. F. Norris, of Maryland, was professor of chemistry at Vanderbilt University for a short period and has been professor of chemistry at the Massachusetts Institute of Technology since 1916 He has written text-books and is the author of numerous papers on chemical subjects. Norris also is a past president of the American Chemical Society. H. C. Sherman, of Virginia, has been professor of chemistry at Columbia since 1905 He has contributed largely to the chemistry of food and nutrition. Sherman is a past president of the American Society of Biological Chemists S C. Lind, of Tennessee, served as physical chemist of the U. S Bureau of Mines for several years and then as chief chemist. He has been director of the school of chemistry, University of Minnesota, since 1926. He is assistant editor of two chemical journals Lind has received the Nichols Medal for his work on chemical activation by alpha particles C S Hudson, of Georgia, is chief chemist of the U. S Bureau of Standards Hudson has received the Nichols Medal and the Willard Gibbs Medal for his researches on the structure of sugars G W. Carver, of Missouri, who was awarded the Spingarn Medal in 1923, is director of the department of agricultural research, Tuskegee Institute

It is interesting to note that the first professor of physics at Johns Hopkins, Henry A Rowland (1848–1901), of Honesdale, Pennsylvania, received his appointment on the same day that Remsen was made professor of chemistry at that institution Rowland remained in the chair of chemistry for a quarter of a century and became famous because of his work on the mechanical equivalent of heat G B Pegram, of North Carolina, has been professor of physics at Columbia University since 1909 He has been dean of the School of Mines, Engineering, and Chemistry since 1918 at the same institution Fred Allison, of Virginia, has recently announced the discovery of element 87 Allison has been professor of physics at Alabama Polytechnic Institute for several years

The science of mathematics is closely associated with physics and Archibald Henderson, of Salisbury, North Carolina, has been connected with his alma mater, his state university, most of the time since 1899, and has been head of the department of mathematics since 1920 And R D. Carmichael, of Goodwater, Alabama, is one of the representatives of that field who should not be overlooked. He has taught at the University of Indiana and the University of Chicago, and has been professor at the University of Illinois since 1915 Carmichael has been associate editor and editor of two mathematical journals and has been a constant contributor of original articles.

Again, it is Alabama that has given a noted son, W. L. Sibert, who served as engineer in charge of the eastern part of the Isthmian Canal He built the Gatun Locks and Dam and excavated the channel from Gatun to the Atlantic Ocean He was chief engineer of the Mobile Docks, which were recently completed. During the World War, Sibert organized the Chemical Warfare Service and became the director. M. S. Sloan, of Mobile, Alabama, received his education at Alabama Polytechnic Institute and has served in various capacities as engineer for several electrical concerns and is president of the Brooklyn Edison Co., Inc. W. H. Browne, of Baltimore County, Maryland, received his education in the South and did consulting work in electrical engineering for several years He taught electrical engineering at Nebraska and Illinois and then in 1908 became professor of this subject and physics at North Carolina State College, where he has been head of the department of electrical engineering since 1916 A S Langsdorf, of St Louis, received his training at Washington University He was called to the chair of electrical engineering at the same school in 1901 He was appointed dean of the school in 1910 and served in that capacity for ten years Langsdorf has been director of the department of industrial research at Washington University since 1926

The accomplishments of inventors do not pertain to any one branch of scientific endeavor, yet it is interesting to note that the South had a marked influence on Eli Whitney, the Yankee schoolmaster from Massachusetts Whitney had never seen a cotton seed until he came to Georgia to tutor some children When he arrived, the position had been filled. He then accepted the invitation of the widow of General Nathanael Greene to make her place at Mulberry Grove his home while he studied law Since he had shown his mechanical ability in other matters on previous occasions, Mrs. Greene asked Whitney to help devise some mechanical means of separating the cotton wool from the cotton seed. Whitney built the first cotton gin and later patented it

In the multiple field of the medical sciences, there have been so many great men that the logical order of review becomes a problem at this point It has long been considered that anatomy should come first, due to seniority, if not to alphabetical place, and we shall accept it as our first topic of the medical sciences W E Horner (1793–1853), of Warrenton, Virginia, served as army surgeon in the War of 1812 and later practiced medicine for a short while in his home town He became prosector of anatomy in the University of Pennsylvania, and finally accepted the chair of anatomy in the same institution He discovered the *tensor tarsi muscle* which bears his name, and contributed several original papers on anatomical subjects. Next we shall take up the study of the contributions of John D Godman (1794–1830), of Annapolis, Maryland He practiced medicine in his state and in Pennsylvania. Godman taught anatomy in three schools, one of them being the University of Maryland. He became the editor of the *Western Quarterly Reporter of Medical, Surgical, and Natural Sciences*, the first medical journal to be published west of the Alleghenies. Godman also assisted in editing the *Philadelphia Journal of Medical Sciences* We might add the name of Jeffries Wyman (1814–1874), of Chelmsford, Massachusetts, even though he spent the major portion of his scientific career at Harvard, his alma mater A few years after graduating he accepted the chair of anatomy and physiology at Hampden-Sidney College, Virginia Wyman was another prolific writer and wrote over two hundred articles.

There are several living anatomists who should be included in this paper Charles R Stockard, of Mississippi, has edited three journals and has personally been a constant contributor Stockard has been professor of anatomy at Cornell for twenty-two years. Irving Hardesty, of North Carolina, has been professor of anatomy at Tulane for the same length of time Hardesty has published numerous papers on the nervous system Ross G Harrison, of Pennsylvania, taught anatomy at Johns Hopkins for eleven years and has been at Yale for twenty-four years as professor of anatomy and biology His name is usually connected with the work on the growth of nerve fibers He has edited the *Journal of Experimental Zoology* since 1903 Warren H Lewis, of Connecticut, has been professor at Johns Hopkins since 1904 He has been research associate at the Carnegie Institution of Washington since 1919, and has published many articles

Since surgery is so closely associated with anatomy, it is fitting to discuss it next. Regardless of time or place, the great southern gynecologist, Ephraim McDowell (1771–1830), of Rockbridge County, Virginia, stands second to none among surgeons He was educated in the South except for the part of his medical work which he took in Edinburgh. He practiced medicine in Danville, Kentucky, and in 1809 he successfully performed the operation for extirpation of the ovary, the first on record, and in consequence he acquired European celebrity. He performed this operation thirteen times, and had eight recoveries. His first patient lived for thirty-three years after the operation. To McDowell has been given the credit for putting ovariotomy upon a permanent basis. James Marion Sims (1813–1883), of Lancaster County, South Carolina, settled in Alabama and became interested in operative gynecology. He is noted for his contributions to uterine surgery, both mechanical and operative, his name being associated with the peculiar lateral posture, which he employed during his examinations, Sims' position. He is especially remembered for his success in operating for vesicovaginal fistula. He was the founder of the State Hospital for Women in New York. The work of Sims was continued by his able assistants, Thomas A. Emmet, of Virginia, and Nathan Bozeman, of Alabama.

There are several other gynecologists who have made worthy efforts that deserve mention. John King, of South Carolina, in 1816, operated successfully in a case of abdominal pregnancy and saved the life of both the mother and child He is the author of the first book on "An Analysis of the Subject of Extra-uterine Foetation, and of the Retroversion of the Gravid Uterus." William Baynham (1749–1814), of Virginia, operated twice for extra-uterine pregnancy and was successful in both instances Josiah Clark Nott (1804–1873), of Columbia, South Carolina, in 1844 described the condition which was later called coccygodynia. He was one of the first to suggest the "mosquito theory" in reference to the transmission of yellow fever, some fifty years before Reed and his commission assembled in Cuba. We, of Alabama, feel grateful to Nott because he was instrumental in organizing the Medical College of Alabama at Mobile, which was the forerunner of our present School of Medicine. T G Thomas, of South Carolina, performed the first vaginal ovariotomy in 1870 Robert Battey, of Georgia, in 1872, was the first to suggest the excision of the uterine appendages for such non-ovarian conditions as neuroses and painful menstruation. F. C. Hammond, of Georgia, has served both as professor of gynecology and as dean of the medical department, Temple University. To McDowell and Sims, however, goes the credit for founding modern operative gynecology Another surgeon, William Gibson (1788–1868), of Baltimore, Maryland, finished his education at Edinburgh. He was the first to successfully perform the Caesarean operation twice with success to both mother and child on the same patient, the patient living for fifty years after the first operation. His son, Charles Bell Gibson, became professor of surgery in two Southern schools and was made surgeon-general when the state of Virginia seceded.

Anesthesia was introduced in cases of surgery by Crawford W. Long (1815–1878), of Danielsville, Georgia, who noted the anesthetic effects of ether and used it quite extensively in surgery during 1842 and 1843. He was not aggressive and ambitious and did not publish his results. Documentary evidence, however, has been found which clearly proves that Long was the originator of anesthesia in surgery.

Samuel D. Gross (1805–1884), of Easton, Pennsylvania, was professor of surgery at Louisville for sixteen years before going to Jefferson Medical College in 1856. He invented new instruments and introduced deep stitches in wounds of the abdominal wall. He was an interesting writer, and we are especially indebted to him for his biographies of some of the leading medical men. Gross wrote also a system of surgery in two volumes.

John A. Wyeth (1845–1922), of Missionary Station, Alabama, received his medical training at the University of Louisville. He organized and founded the first postgraduate medical school in the United States, the New York Polyclinic Medical School and Hospital. Wyeth was the first professor of surgery and president of the faculty.

Due to the breadth of the field that I have undertaken to cover, I can only list briefly the names and accomplishments of a few more of the Southern surgeons who have originated some particular method or technique. Charles McCreary, of Kentucky, was the first to excise the clavicle in an operation performed in 1813. Milton Anthony, of Georgia, excised the fifth and sixth ribs with a portion of gangrenous lung in 1821 Paul F Eve, of Georgia, removed a large fibrous polyp from the base of the cranium in 1836 John M Carnochan, of Georgia, removed the ulna with preservation of the arm function in 1853. J. T Hodgen, of Kentucky, devised instruments and suspension splints for fracture of the femur and forearm that are still in use.

Another branch of medical science, pharmacology, has attracted a few men Arthur S. Loevenhart (1878–1928), of Lexington, Kentucky, served as professor of that subject at two universities and as chief pharmacologist of the research division, Chemical Warfare Service, American University, in 1918. Loevenhart served as associate editor of the official organ of his field. Physiology is one of the sciences that is so closely associated with pharmacology that some schools include both subjects in one department. An investigator who has been professor of both subjects is W D. Cutter, of New York. Cutter taught at the University of Georgia for several years He has served as dean of the New York Post-Graduate School and is now dean of the School of Medicine of the University of Southern California. Henry Sewall, of Virginia, taught physiology for twenty-six years and is professor emeritus of the University of Colorado. Sewall has recently been awarded the Kober Medal for research work in tuberculosis. W. H. Howell, of Maryland, who has been on the faculties of three universities and been dean of the medical faculty of Johns Hopkins, is at present director of the School of Hygiene of the same university. Howell is a recognized leader in the field and was so honored at the Thirteenth International Physiological Congress in 1929 Isaac H. Manning, of North Carolina, has been professor of physiology at the University of North Carolina since 1901 and dean since 1905.

There is another branch of the sciences that has long been associated with physiology, but which has been given recognition as an individual subject only in comparatively recent years I have reference to biochemistry or physiological chemistry. I shall begin with Victor C. Vaughan (1851–1930), of Mt. Airy, Missouri. He taught chemistry in the department of medicine, University of Michigan, for thirty years and served as dean for an equal period. Vaughan is known for his work on poisonous alkaloids, ptomaines and cellular toxins. Walter Jones, of Maryland, was professor of physiological chemistry at Johns Hopkins from 1895 to 1927, at which time he was made professor emeritus. Jones has been an untiring investigator in nuclear chemistry. William J. Gies, of Maryland, taught at Yale and Columbia and was made professor emeritus of Columbia in 1929 after thirty-one years' service. He was secretary of the faculty of the College of Physicians and Surgeons from 1905 to 1921. He was the founder and editor of the *Proceedings of the Society for Experimental Biology and Medicine*. Gies has been assistant editor and editor of four other journals, and has contributed numerous original articles. P. A. Shaffer, of West Virginia, has been professor of biochemistry at Washington University since 1910 and was dean of the faculty of medicine from 1915 to 1919. J. F. McClendon, of Alabama, has been associated with the department of physiological chemistry at the University of Minnesota since 1914, and has been professor since 1920.

There are several pathologists of the South who have not only influenced the medical sciences by their own personal investigations but have also been influential because most of them have been directors of scientific institutions. Simon Flexner, of Kentucky, has taught at two universities and has been director of the Rockefeller Institute for Medical Research since 1903. Flexner's researches include work on venoms and various bacterial and pathological subjects. W. H. Manwaring, of Virginia, received his early training at the University of Chicago and then became connected with Indiana University and later with the Rockefeller Institute. Manwaring has been professor of bacteriology and experimental pathology at Stanford University since 1913. David Marine, of Maryland, who has been teaching at Columbia University, recently received the gold medal of the New York Academy of Medicine for his researches into the structure, function and diseases of the thyroid gland. Eugene L. Opie, of Virginia, served as professor and dean of Washington University, School of Medicine, and has been director of the department of pathology at the University of Pennsylvania for eight years. Newton Evans, of Missouri, taught pathology at the University of Tennessee and at the College of Medical Evangelists. Evans is dean at the latter institution. Milton C. Winternitz, of Maryland, was professor of pathology at Johns Hopkins and at Yale and has been dean of the School of Medicine at Yale for eleven years. Wade H. Brown, of Georgia, taught at two Southern universities before becoming connected with the Rockefeller Institute for Medical Research. William A. Evans, of Alabama, was professor at the University of Illinois for several years and is now professor of sanitary science at Northwestern University Medical School.

The men interested in medicine, clinical medicine and preventive medicine have been rather numerous, and it was a difficult task to select the individuals whom I shall discuss but briefly. Nathaniel Chapman (1780–1853), of Virginia, was professor of clinical medicine at the University of Pennsylvania for several years. He founded and edited the *Philadelphia Journal of the Medical and Physical Sciences*, later the *American Journal of the Medical Sciences*. Chapman was the first president of the American Medical Association. The cultivation of all three species of malaria was performed by C. C. Bass, of Mississippi, who has received several gold medals for his researches. Bass has served as professor of experimental medicine, director of the laboratory of clinical medicine and dean at the College of Medicine, Tulane. Manfred Call, of Virginia, a former dean at the Medical College of Virginia, is professor of medicine at the same school. James C. Flippin, of Virginia, another teacher of clinical medicine, served the University of Virginia as professor and is dean of the department of medicine. John N. Simpson, of West Virginia, organized the School of Medicine, West Virginia University, and became professor of medicine and dean. Robert Wilson, of South Carolina, has been associated with the medical college of his state since graduating in 1892. Wilson has been professor of medicine for twenty-seven years and dean for twenty-three years. Ross V. Patterson, of Louisiana, has been professor of medicine and dean of Jefferson Medical College for fifteen years. James S. McLester, of Alabama, was formerly professor of medicine at the Birmingham Medical College and has had the same title at the University of Alabama for twelve years. George C. Robinson, of Maryland, has been professor of medicine and dean of Washington University, Vanderbilt University and Cornell University. M. P. Ravenel, of South Carolina, has been professor of medicine at the University of Missouri and the director of the Public Health Laboratory since 1924. Alan M. Chesney, of Maryland, is another individual who has risen from the ranks in his alma mater. Chesney has been dean of Johns Hopkins since 1929. W. S. Leathers, of Virginia, was dean of the Medical School, University of Mississippi, for twenty years and has been professor of preventive medicine, Vanderbilt University, since 1924.

I shall mention only a few representatives in some of the other medical sciences. Frank Vinsonhaler, of Missouri, has been professor of ophthalmology at the University of Arkansas since 1893 and is at present dean of the medical school James M H Rowland, of Maryland, has been professor of obstetrics at the University of Maryland and dean of the Medical School since 1915 Henry A Christian, of Virginia, has been professor of the theory and practice of physic for more than twenty years at Harvard. He served as dean of the same school for four years. In addition, Christian has been physician-in-chief to Peter Bent Brigham Hospital for twenty years W McKim Marriott, of Maryland, began his training as a biochemist at Washington University, but changed to pediatrics when called to Johns Hopkins He later returned to Washington University as professor of pediatrics, and has been dean for several years W H Frost, of Virginia, formerly with the Hygienic Laboratory at Washington, D C, has been connected with the United States Public Health Service since 1913

There have been some men, born in other places than the South, who have taught in the South and who should be listed in a paper of this nature Certainly this report should contain the name of Sir William Osler (1849–1919), of Tecumseh, Ontario, who taught at Johns Hopkins from 1889 to 1905 Osler is noted also for his writings and is particularly remembered for certain of his biographical essays, one of which is "The Alabama Student," a portrayal of the character of Dr John Y Bassett, of Huntsville, Alabama. William H. Welch, of Connecticut, was professor of pathology at Bellevue Hospital Medical College from 1879 to 1884 and for the next thirty-two years at Johns Hopkins. Welch was dean of the medical faculty from 1893 to 1898, and was director of the School of Hygiene and Public Health from 1916 to 1926. Since 1926 Welch has been professor of the history of medicine at Johns Hopkins William S Thayer, of Massachusetts, was professor of clinical medicine at Johns Hopkins for several years and is professor emeritus of the same institution. Thayer has been a thorough investigator, and he made the first clinical notation of the third sound of the heart in 1908.

In order to show you further that the South has played a great part in furnishing directors for scientific groups, I shall make use of some statistics concerning the present deans of the medical sciences The recent standard references list sixty-three of the seventy-five deans, and twenty-nine of these were influenced by the South to the following extent: Three were born in the North and received the doctor's degree in the South; six were born in the North and received the doctor's degree in the South and taught in the South before becoming deans, nine were born in the South and educated in the South, except for the work for the doctor's degree, eleven were born in the South and wholly educated in the South.

I know of no more fitting close for this paper than to summarize the works of the Southerners who played the principal part in the suppression of yellow fever. Virginia gave us the leader of this series of great scientific achievements, Walter Reed (1851–1902), who received his medical training in his state university He was promoted to full surgeon with the rank of major in 1893 and became professor of bacteriology in the newly organized Army Medical School. Reed went to Cuba in 1900 as president of a commission to study yellow fever The theory had been advanced by Josiah Clark Nott in 1848 that a mosquito was the agent for the transmission of the disease, but there was no scientific evidence in support of it Reed determined to study the effect of the bite of the mosquito Two of the commission and several enlisted men volunteered to submit to this experiment Dr Jesse W Lazear (1866–1900), of Baltimore, who had offered himself as one of the first volunteers, succumbed to the fever, and his death was the only fatality during the experiments. Another one of the commission, James Carroll, suffered a very severe attack of the fever, but recovered

The prevention of the disease was left to the chief sanitary officer in Havana, Major William Crawford Gorgas (1854–1920), of Mobile, Alabama. In less than seven months, Havana was free from the stegomyia mosquito, which had infested it for one hundred and fifty years. Gorgas was appointed the chief sanitary officer of the Panama Canal in 1904, and a member of the Isthmian Canal Commission in 1907. Due to his sanitary measures, it was possible to complete the canal, a project which France had failed to accomplish because of the ravages of yellow fever and other tropical diseases. Gorgas was made surgeon-general in 1915 and continued his sanitary work until his death. He was the recipient of several medals and his work was recognized by kings and governments throughout the world.

The above investigators, whom I have briefly mentioned, can be only an indication as to the type of scientist the South has produced or influenced. And this paper is but a short discussion of Southern men of science whose lives and works have become familiar to the writer through personal communication and through reading.

OBITUARY

SAMUEL WESLEY STRATTON

1861–1931

Dr. Samuel Wesley Stratton died suddenly at his Back Bay home of coronary occlusion on October 18, at the age of seventy He had just dictated a tribute to Thomas A Edison, whose death occurred a few hours before His tribute to Edison reads in part "It seldom has fallen to the lot of any one man to be of such service to humanity. The world mourns that great benefactor" The tribute might very well have been written for Dr Stratton

Dr Stratton was born in Litchfield, Illinois, July 18, 1861, the son of Samuel and Mary B (Webster) Stratton He was graduated from the University of Illinois in 1884 with the degree of bachelor of science, and afterward went through the usual steps from instructor to professor in physics in this institution In 1892 he left his alma mater to become associate professor and later professor of physics at the University of Chicago, where he remained until 1901, when he was forty years old

During these years he had gained a perspective not only in science but in its broader outlook. He was keenly interested in research I remember, as a cub instructor and research worker at the University of Illinois, seeing some of his personal research material, such as a collection of orifices for the study of the laws of liquid flow, and other special equipment according to his own ideas He was fascinated with the work of Michelson and throughout his life yearned to do similar work himself At forty he was not marked as a genius either as a teacher or as a research worker, but he had made many friends and had extended his understanding of human nature and human values

While he was a student at the university he lived meagerly with Frank A Vanderlip, who has since become the well-known banker and philanthropist. Stratton worked in the machine shops to partly defray his expenses He recognized these as a godfather and he never lost his fondness for machine shops or new developments in machine tools His warmth for machines was somewhat akin to his unconscious warmth toward persons who had befriended him All during his administration at the Bureau of Standards, he not only took pride in developing a most up-to-date and efficient shop, but he also had his own personal shop where he could handle and play with tools. Many times he retired to this as a retreat, as others would go to a mountain top Even at the Massachusetts Institute of Technology he had his personal complete shop, and I have seen most estimable testimony in his work that in his last year his hands had lost none of their skill. In the early days he frequently entertained his shop force at dinner and in the evening. He always deprecated the loss of a skilled machine worker to the white collar class. Like Carlyle, he was aware that machine tools are basic in human contest with the forces of nature He saw Michelson's continued dependency on the precision of his shop work.

His school friend, Mr Vanderlip, became Assistant Secretary of the Treasury from 1897 to 1901, through his instrumentality Dr Stratton was invited to formulate the project for the development of the weights and measures work, then under the control of the Treasury Department Almost single handed he engineered through the enactment of March 3, 1901, which created the Bureau of Standards This at once showed his native ability as a politician and statesman He was, naturally, invited by Secretary Lyman J Gage to become the first director His vision of the usefulness of such a bureau was so clear that during his entire administration he was not handicapped by the organic act, setting forth the functions and scope of activity

Dr. Stratton, like most great men, was modest, even approaching shyness He did not like to give lectures or talks or to make a conspicuous appearance at public affairs, yet no task was shirked if it seemed important to the bureau Organization was his genius Quickly he learned the key men at the Capitol, their interests and their proper approach He formed an intimate acquaintance with Elliott Woods, an able political figure, the superintendent of the Capitol, who figuratively gave him the keys to the back doors Woods was a devotee of science, who found the subject a happy playground He had a continuous set of demonstrations in a group of rooms, showing x-rays, Geissler tubes, spectra of various kinds, and similar exhibits with equipment surpassing that of many a college laboratory Dr Stratton assisted him in setting up many of these. Mr. Woods often invited the Senators, Congressmen and their wives to tea or evening receptions, when regular and special demonstrations would be staged It is not surprising that these guests, many of whom had never seen a science laboratory, should be fascinated with the display of the forces of nature—more mysterious than those in detective stories. Moreover, Mr. Woods was a genial host and he never missed a good opportunity to say that such wonderful things were developed at the Bureau of Standards and, of course, giving more than faint praise to Dr Stratton. With a Congress that was never science-minded, one can readily see the advantage of such interventions. Likewise, the clerk of the appropriations committee of the House became a fast and useful friend to the bureau. From him was learned the proper course to steer appropriations, the idiosyncrasies of the members—and even good stories. I am sure it was a genuine friendship, for Dr Stratton was accustomed to visit his burial place He also became acquainted with the minor as well as the major clerks in the offices of the leaders. I remember his saying that sometimes he thought the Congressmen and Senators got more for their money in employees hired through patronage than could be obtained by any system of formal examination. He was a born democrat. He maintained a manner of respect toward these minor employees as he did toward his chauffeur, his cook or the head of another bureau He seldom intruded on the time of the leaders like Uncle Joe Cannon, but he could always get their attention when it seemed a matter of public interest. The demands of these for special favors from the bureau were rare, although the director treated every request with utmost courtesy If it were a personnel appointment of doubtful value, he would, perhaps, visit the Senator or Congressman, and express appreciation for thinking of the bureau, and then explain the nature of the work and the necessary qualifications and the great difficulty of finding suitable candidates Thus the conversation revealed the candidate's deficiency and the request was usually withdrawn; the institution was a little better understood on the Hill and the director lost no ground. Needless to say, he made it known that all opportunities for service within the bureau's field were courted.

His human approach to a formal hearing before the appropriations committee was interesting I remember on one occasion he took some samples of optical glass and other pretties and laid them out on the table. The committeemen thought they understood these and enjoyed the entire story The ice was broken and the hearing proceeded easily

Dr Stratton's heart and home was the Bureau of Standards. His dynamo of energy and ability was running there as constantly almost as the one in the power plant. He started many researches and took almost as much personal interest in dozens of researches as if he were personally directing them He was busy getting a new testing machine or other equipment, and after that busy finding a suitable means of housing it. The bureau was always needing either equipment to fill out some building or department or some building or land to house the equipment. Thus it grew. The director was ready to advance on many fronts and he advanced where the way was open and reinforced the intrenchments where the way seemed closed. But he was faithful to Congress, as he was also faithful to the bureau and its staff Likewise the director was continually on the lookout for worthy research and testing work, and so the staff always seemed overburdened Consequently he was ever on the lookout for able and qualified men. He was ever alert either to give a research opportunity to a man or to get a man for an opportunity. The bureau loomed up to him like a mountain, so that there rarely seemed to be any equally good place for an effective scientist His hold on his staff was almost uncanny Many a man with full intention of leaving could not make the getaway When I was acting director one of the division chiefs came into the office with his resignation all written and final He admitted my accusation that he would not have had the courage to submit his resignation to Dr. Stratton

His personal characteristics counted as much for his leadership as did his understanding of men I became acquainted with him during the war when it was frequently necessary to seek assistance from the bureau in many ways He was always eager to render help and if he saw the necessity that certain work should be done he would go ahead, forgetting about costs and pay and the like It was of much more concern to do worth-while work than it was to do a good accountants' job When my war work was over, I was standing shaking hands with him and expressing a quick, informal appreciation for the help of the bureau. Within less than a minute he completely surprised me with an invitation to become his assistant. He explained that the position had been authorized for three years, but that he had not found the right man, and further, I could do him great service Beyond that there was no urging, but he knew I was hooked, and after taking a month that seemed like playing between life and death I landed Within a few months I was designated as acting director in his absence. He would usually evaluate a man in his first five-minute contact and rarely found a material revision necessary In case of such revision, it was just too bad for the man There was never any criticism and rarely any direct instruction to those he trusted. His intuition was remarkable The purpose of the visitor to his office was usually clear before the first sentence was completed. This gave him advantage as well as pleasure. Sometimes he could get a good laugh when the game went against him.

Dr. Stratton had an unusual personal interest in his staff, possibly because he had no family of his own. At Christmas there was a Christmas tree and presents for the children of the staff members, and in the late spring he gave a children's party. There was a merry-go-round, a live pony to ride, an organ grinder and a monkey, pink lemonade and balloons. Dr. Stratton observed what went on. He thought children much more fun than monkeys His pleasure lasted long after the party was over It was a joy to him to have one of his secretaries married to one of his research staff right in his own home. He had an especially keen interest in the younger folk. Remembering his own appreciation of work during his college days, there was instituted a system of apprenticeship for ambitious boys, so that they could continue their education. He could not understand those boys who wanted a job at the bureau and who did not continue to take advantage of the educational possibilities. It reminded him of the nice slick pigs that quickly transformed into scraggly or razorback hogs. He had a wealth of such illustrations that seemed to me rather better than the ones by Shakespeare, and he very rarely used the same one twice. Some of these he manufactured himself, others he received from his friend at the meat market where he usually did his daily shopping. His democracy was somewhat like that of our former President who obtained stories from his cobbler. His educated and distinguished pals know where he got some of the others.

Among his bosom friends were the dearest souls imaginable, such as Brashear and Swasey, whom he first joined through common interest in optics and machine work. He also had a particular fondness for the quiet and modest research workers. Several afternoons a week he would walk around visiting these men and bringing a cheer that was invaluable. On his visits to the bureau during the interregnum his only advice to me was to look after the interests of some of these workers.

Dr. Stratton also was anxious that the staff members should continue their personal advancement. Thus he was instrumental in establishing within the bureau an almost complete educational system. Many a doctor's dissertation has been worked out at the bureau and accepted at leading universities. As a recruiting ground for workers in industrial research, it is doubtful if any university surpassed it. The director was ardent in his desire to have the science at the bureau serve the industries of the country. He devised a system of industrial research fellowships to augment this service and to keep the well from going dry.

It is generally known that the Bureau of Standards started long after similar institutions in Europe and that in the twenty-two years it became recognized as a leading institution. The bureau is truly a monument to Dr. Stratton, although I never saw him more perturbed than the time a member of the House openly accused him of spending public money to erect a monument to himself.

Dr. Stratton found it very difficult to leave the bureau to accept the presidency of the Massachusetts Institute of Technology. Because of the industrial situation at the time, all New England joined in the call of the institute and it was thus irresistible. His good work there, eight years as president and finally chairman of the corporation, is well known. It was most fitting that a memorial meeting was held at the bureau simultaneously with the services at the institute.

His friends were planning a national dinner to honor his seventieth birthday, but his spokesman gave assurance that this could not be acceptable. Dr. Stratton was not a master publicity man of the kind known to high-pressure salesmen, but immortality has come to him because of his work and by the many touches from his warm and wise personality. His influence on science and industry in this country has been so great and so ramified that any superlative would be inadequate. His recognitions were many. He received the degree of doctor of science from the University of Pittsburgh in 1903, the same degree from Cambridge University (England) in 1909, the LL.D. from Harvard in 1923 and later from Yale, and the Ph.D. from Rensselaer Institute in 1924. He was a member of Tau Beta Pi, Sigma Xi and Phi Beta Kappa. For years he was an officer in the Naval Reserve, and he was in active service during the Spanish War. He was a commander of the Legion of Honor. The Elliott Cresson Medal of the Franklin Institute was bestowed upon him. His membership included the National Academy of Sciences, the National Research Council, the American Physical Society, the Optical Society of America, the Franklin Institute, the Philosophical Society of Washington, the Washington Academy of Sciences, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the International Committee of Weights and Measures. Among his club memberships may be listed the Cosmos, Chevy Chase and Army and Navy, of Washington, D. C., the Algonquin, Union, Tavern, Engineers, and University, of Boston, and Union Inter-Allee of Paris.

His duties in organizations, as president, as chairman, trustee, committeeman, or member of board, were too numerous to describe here. These generally carried a public duty, in science, industry, government, in a society, a public institution or even in a judiciary group. He gave to these himself wherever possible. On occasion it was necessary for me to substitute and report to him in such groups as the National Advisory Committee for Aeronautics, the Ice Patrol Board, the Industrial Conference Board, the National Screw Thread Commission, the President's Interdepartmental Patents Committee and the like. Sometimes he would hold similar responsibilities because of his sense of personal obligation. I know he continued to attend the trustees' meetings of the New York Museum of Science and Industry because he could help me. He seemed to regard a personal obligation as a privilege, and he was rarely conscious that he had more than done his part.

F. C Brown

RECENT DEATHS

Dr John Whitridge Williams, professor of obstetrics at the Johns Hopkins University Medical School since 1893 and dean of the school from 1910 to 1923, died on October 22, at the age of sixty-five years

Dr Joseph Merritt Matthews, authority on textile chemistry and dyestuffs, died in San Diego, California, on October 12, aged fifty-seven years. For some years Dr. Matthews was professor of chemistry and dyeing in the Philadelphia Textile School

Mr. Henry Lorenz Viereck, an authority on the Hymenoptera, was killed in an automobile accident at Loudonville, Ohio, on October 9 Dr Viereck was fifty years old

Colonel John S A Johnson, professor of applied mechanics and experimental engineering and director of the experiment station at the Virginia Polytechnic Institute, was recently found shot to death in his bedroom at his home on the campus He was fifty-three years old and had been professor at the institute since 1900

SCIENTIFIC EVENTS

THE NEW FEDERAL CITRUS FRUIT LABORATORY IN TEXAS

Dr Henry G Knight, chief of the bureau of chemistry and soils of the U S Department of Agriculture, recently announced that a new citrus laboratory of the bureau, for which funds were appropriated by the last Congress, will be established in the citrus-growing territory of the Rio Grande Valley at Weslaco, Texas, on the state-owned land of the Texas State Experiment Station for the study of citrus fruit culls and their by-products

The selection of a site on the agricultural experiment station grounds at Weslaco was made upon recommendation of Dr F C Blanck, in charge of the food research division of the bureau of chemistry and soils, and Mr E M Chace, of the bureau's fruit and vegetable laboratory at Los Angeles, California, with the approval of Director A B Conner, of the Texas Agricultural Experiment Station

The chambers of commerce of Weslaco and Mercedes, Texas, have agreed to erect a suitable building for the citrus work of the bureau In recommending this site for the bureau's by-product work with citrus fruits, the department specialists said "We feel that the selection of Weslaco is absolutely logical and that it offers special advantages, because of the effective cooperation with the state experiment station which it makes possible and because our work at Weslaco will be located in the center of the citrus-growing territory of Texas"

Director Conner, of the Texas Agricultural Experiment Station, in commenting on the establishment of the federal work in the utilization of citrus by-products, says· "The location of this proposed laboratory at the substation ought to be mutually advantageous to agencies working in behalf of the citrus industry With the concentration of both federal and state activities at this one station, it will receive increased recognition as a center of research for the Texas citrus-producing industry."

Dr Knight states that work will begin on problems of citrus-fruit utilization at the bureau's new laboratory as soon as the buildings are completed and the equipment is installed, and that the first year's work will center largely upon problems of grapefruit utilization The laboratory, he says, will study the composition of different varieties of Texas grapefruit to learn what stage of maturity is most favorable for preservation Other studies will center upon utilization of waste from canneries and juice factories, and the feasibility of preparing grapefruit oil, pectin, naringin and other valuable constituents from oil and waste material

The assistance which similar laboratories of the Department of Agriculture have rendered citrus-fruit growers of California and Florida in solving problems of by-product disposal has led to the extension of this work to Texas, fruit growers of that state having made repeated requests for such aid Total plantings of citrus in Texas amount to approximately 6,650,000 trees, of which about one half are in bearing This represents an acreage of about 90,000, with grapefruit accounting for three fourths of the total

PSYCHIATRIC EDUCATION

In order to meet the growing demand for trained workers in psychiatry and mental hygiene the National Committee for Mental Hygiene has created a new division of psychiatric education, Dr C. M. Hincks, director of the committee, has announced in a statement sent out by Science Service

"The dearth of competent psychiatrists is becoming a major issue in human welfare," a committee of the American Psychiatric Association, which has been studying the problem, has concluded

"It is no longer merely a matter of overcrowded mental hospitals in which the patients receive but momentary attention from the mental specialists. We are confronted by a matter amounting to a national emergency," their report stated.

Of the 160,000 physicians in the United States today, somewhat over 40,000 are specialists in the various branches of medicine. Of these only 1,600 are psychiatrists, or one in twenty-five. In other words, there are a hundred times as many doctors in physical as in mental medicine, the committee pointed out. This is out of all proportion to the magnitude of the problem of nervous and mental disease. Half of the hospital beds of the country are occupied by patients suffering from mental disease, and there are many more not in hospitals

The new division of psychiatric education will center its work largely around the medical schools, with a view to attracting more medical students to this branch of medicine and to giving those who plan to engage in other specialties or in general medicine instruction which will better equip them for dealing with such problems of mental health as will inevitably arise in their work

The director of the division will be Dr Ralph A. Noble, of Sydney, Australia, and associated with him will be Dr Franklin G Ebaugh, director of the Colorado State Psychopathic Hospital

THE NINTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY

THE Ninth International Congress of Pure and Applied Chemistry is to be held under the patronage of the Government of the Spanish Republic in Madrid, from April 3 to April 10, 1932. It will be twenty years since such an international congress has been held, the eighth having met in Washington and New York in 1912

According to a statement in *Industrial and Engineering Chemistry,* the National Council of the Spanish Federation of Chemical Societies, upon which the Spanish Society of Chemistry and Physics, the Society of Spanish Mining Engineers, the National Union of Chemical Experts, the Academy of Sciences, the Institute of Oceanography and the National Chamber of Chemical Industries are represented, is the body which is affiliated with the International Union and which has the responsibility for the details of the congress. The honorary president is J. R Mourelo, vice-president of the Academy of Sciences and professor emeritus of the School of Arts, University of Madrid, the president, O Fernández, professor of the University of Madrid, member of the Academy of Sciences, and dean of the Academy of Pharmacy; the general secretary, E. Moles, professor of the University of Madrid, and of the National Institute of Chemistry and Physics, as well as president of the Spanish Society of Chemistry and Physics.

The rules which will govern the congress are in part as follows:

I. The object of the Ninth International Congress of Pure and Applied Chemistry is to further the progress of pure chemistry and all its applications, as well as to strengthen relations between chemists the world over

II. Any person professing interest in any one or more of the objects of the congress may enroll as a member

III The membership of the Ninth International Congress of Chemistry shall be divided into three categories, *viz :*

(*a*) *Honorary Members* All members of the Committee of Honor and of Patronage, the official delegates of the Spanish government and of the governments of other countries.

(*b*) *Supporting Members* · All persons who individually (whether payment be made in joint accounts or in any other manner) pay the minimum amount of 250 gold pesetas

(*c*) *Active Members* All who pay the general fee of 50 gold pesetas The application for membership shall vouch for the applicant's agreement to all the rules and regulations of the congress. All members shall be entitled to receive all publications *in extenso,* to take part in the sessions of the congress and to receive copies of the daily newspaper which will be published, as well as a separate issue of all the summaries of the communications and documents referring to the congress, including the final report on the proceedings Members shall also be entitled to attend the receptions and festivities in connection with the congress, unless otherwise indicated on the program, which will accompany the identification cards.

IV Tickets at 15 gold pesetas each will be issued for ladies wishing to accompany the members of the congress They will be granted the same privileges as members except that they will not be allowed to take active part in the sessions, or receive publications.

V The congress will be divided into the following groups, each of which will have a section on pure, and one on applied, chemistry; Group 1, physical and theoretical chemistry; Group 2, inorganic chemistry; Group 3, organic chemistry; Group 4, analytical chemistry, Group 5, biological chemistry; Group 6, teaching and economics. The executive committee is authorised to increase the number of sections as the need of the congress may demand.

THE HENRY BURCHARD FINE HALL OF MATHEMATICS

THE Henry Burchard Fine Hall of Mathematics was dedicated at Princeton University on October [illegible].

The hall has been erected at a cost of $500,[illegible] in memory of the late Professor Fine, who [illegible] department of mathematics at Princeton University and was for twenty years dean of the department of science. The money for the erection and an endowment of $150,000 for its upkeep were given shortly after Dean Fine's death in 1928 by the late Thomas D. Jones and his niece, Miss Gwethalyn Jones, of Chicago

The new structure is in the southeastern portion of the campus, adjoining and connected with the Palmer Physical Laboratory It is built of red brick and limestone and was designed by Charles Z Klauder, of Philadelphia, in collegiate Gothic style to conform with neighboring campus buildings Overstuffed chairs and davenports take the place of chairs and desks and the classrooms are fitted out after the manner of private studies.

Mathematical formulae have been used as decorative motifs of the building Designs on some of the windows include the Newtonian equation of gravitation, formulae of Einstein, two equations on the quantum theory, the five perfect solids and spheres and the three conic sections Over the fireplace in the common room is engraved a German quotation from Einstein.

Preceding the dedication, Professor Gilbert A. Bliss, of the University of Chicago, and Professor George D Birkhoff, of Harvard University, read papers in one of the lecture rooms Both are former teachers at Princeton University

SCIENTIFIC NOTES AND NEWS

The corner-stone of the New York State Theodore Roosevelt Memorial at the American Museum of Natural History was laid by Governor Franklin D Roosevelt on October 27

The Baly Medal of the Royal College of Physicians, which was awarded to Dr. Walter Bradford Cannon, professor of physiology in the Harvard Medical School, will be presented to him in November, as announced by Lord Dawson of Penn at the annual Harveian commemoration of the college on October 18 The Harveian oration was delivered by Dr Robert Hutchison on "Harvey, the Man and His Methods: A Message for Us To-day"

In recognition of his research work in dental nutrition, Dr Percy R. Howe, professor of dental science in Harvard Medical School, director of the Forsyth Dental Infirmary and past president of the American Dental Association, has been awarded the 1931 Fauchard medal presented by *Dental Survey.*

At the forty-second annual meeting of the German Pediatric Society, Dr. Alfred F. Hess, of New York, and Dr Henry J. Gerstenberger, of Cleveland, were elected to honorary membership.

A dinner in honor of Dr. Charles Wardell Stiles will be given at the Cosmos Club, Washington, on November 7. Dr. Stiles retired from active duty in the U. S. Public Health Service on October 1, after more than forty years of service in the government

The first Joseph Henry Lecture under the auspices of the Philosophical Society of Washington was given at the Cosmos Club, Washington, by President Joseph S. Ames, of the Johns Hopkins University, on October 24. His subject was "Certain Aspects of Henry's Experiments on Electro-Magnetic Induction."

Dr. William H. Welch, professor emeritus of the history of medicine at the Johns Hopkins Medical School, spoke on October 23 at the first of an annual series of "Field Nights" to be held by the University Club, of which he is president Dr Welch, who recently returned from abroad, spoke on European medical and scientific congresses and celebrations, at several of which he was the principal speaker and guest of honor

Dr. T M. Broderick, for the past eleven years chief geologist of the Calumet and Hecla Mining Company and previously assistant professor of geology at the University of Minnesota, has been appointed research professor of geology at the Michigan College of Mining and Technology He retains his connection with the mining company, at the college he will devote most of his attention to investigating the utilization of low-grade iron ores. Further appointments are Dr. Irwin Roman, formerly on the staff of Vanderbilt University and later mathematical physicist with the Geophysical Research Corporation, as assistant professor of mathematics and physics; Dr F A Rohrman, of Columbia University, as assistant professor of chemical engineering; E. W. Schilling, of Iowa State College, as assistant professor of electrical engineering; H. W. Risteen, of the University of Wisconsin, as assistant professor of mechanical engineering, Dr L. W. Eastwood, E. J. Townsend, T. R Maki, William Gerts and Lloyd Staples, as instructors in various technical departments.

Dr. James A. Crabtree, director of the division of preventable diseases in the Tennessee state department of health, has been appointed assistant professor of epidemiology at the Johns Hopkins University School of Medicine.

Miss E. Katharine Wright, formerly associate professor of chemistry at North Carolina College, Greensboro, N. C., is now professor of chemistry at Constantinople Woman's College.

Dr. Arthur J. Mix, professor of botany at the University of Kansas, has been made head of the department.

Dr. J. H. Hoskins, associate professor of botany at the University of Cincinnati, has been made chairman of the department of botany.

Mr. John T. Sanford, curator of geology and paleontology of the Buffalo Museum of Science, has become instructor in geology at the University of Rochester.

Mr. R. W. Sandelin has been appointed instructor in the chemistry department, Georgia School of Technology, Atlanta, Georgia.

The Medical Fellowship Board of the National Research Council, of which Dr. G. Carl Huber is chairman, has made the following appointments of fellows in medicine for the year 1931–32: Louis B. Laplace, Paul E. Steiner, Phillips Thygeson and Cecil J. Watson. The spring meeting of the board will be held in the latter part of March, 1932, and applications to be considered at that time should be filed on or before February 15.

W. Rudyerd Boulton, formerly a member of the staff of the Carnegie Museum of Pittsburgh, has been appointed assistant curator of birds in the department of zoology at the Field Museum of Natural History.

Dr. Stanley Harcourt Peppard, formerly of New York, has been appointed director of the bureau of mental hygiene of the state department of health of Connecticut. He succeeds Dr. James L. McCartney.

Mr. R. F. Mehl, superintendent of the division of physical metallurgy of the Naval Research Laboratory in Washington, has been appointed assistant director of research and head of the physical science department of the American Rolling Mill Company, of Middletown, Ohio.

Roger W. Truesdail, formerly assistant professor of chemistry in Pomona and Claremont Colleges, has resigned and established a consulting and research practice in biological and nutritional chemistry in Los Angeles.

Engineer Captain J. B. Pulliblank has been appointed a naval aide-de-camp to the King of England, from September 8, in succession to Engineer Captain R. Beeman, who has been promoted to engineer rear-admiral.

Having reached the statutory age for retirement, Mr. H. A. Hunt has retired from the position of meteorologist to the Commonwealth of Australia. Mr. W. S. Watt has been appointed his successor.

Dr. Leriche, professor of clinical surgery at Strasbourg University, has been appointed professor of external pathology of the medical faculty of the University of Lyons.

Mr. Ben P. Bole, Jr., Cleveland, Ohio, has returned from the Olympic Peninsula of Washington with more than 600 specimens of small North American mammals and a 550-pound bear for the American Museum of Natural History. He was accompanied by Mr. Frank C. Hibben, of the museum staff.

Professor Bernhard Nocht, formerly director of the Tropical Institute at Hamburg, has gone to Brazil to study leprosy, at the request of the League of Nations.

Dr. Hilmar Ødum, of the Geological Survey of Denmark, Copenhagen, has been in Washington studying Eocene and Upper Cretaceous fossils at the National Museum and the organization and methods of the ground water division of the Geological Survey.

Dr. J. F. van Bemmelen, professor emeritus in zoology at the University of Groningen, Holland, arrived in New York on October 20. He will give a series of lectures in Boston.

Dr. C. B. Bridges, of the Carnegie Institution of Washington, working at the California Institute of Technology, gave an address on "Genic Balance and Related Problems" at a meeting of the Genetical Society, London.

Dr. Alfred V. Kidder gave a lecture at the Carnegie Institution of Washington on October 27 on "The Survey of Yucatan, a Cooperative Study of the Maya Indians, Ancient and Modern."

Dr. Arnold Gesell, of Yale University, has delivered a lecture on "The Psychology of Growth," illustrated with motion pictures, at the New School for Social Research. Dr. Joseph Jastrow introduced the speaker.

On October 15 and 16, three lectures were delivered at the University of Michigan by Professor R. Woltereck, of the University of Leipzig. The titles were as follows: "Genetics and the Biology of Lakes and Islands", "Present State of the Marine and Freshwater Biology in Europe", "Stratification, Movement and the Shape of Pelagic Cladocera."

The following illustrated popular lectures on astronomy are being given at Los Angeles, under the auspices of the Astronomical Society of the Pacific and the Mount Wilson Observatory of the Carnegie Institution of Washington: November 20, "What

Happens in Sun Spots?" Dr. Henry Norris Russell, of Princeton University; December 18, "The System of the Stars," Dr Joel Stebbins, of the University of Wisconsin, January 6, "The Size of the Universe," Dr Willem de Sitter, of the University of Leyden, February 19, "The Stars about Us," Dr Frederick H Seares, of the Mount Wilson Observatory, March 18, "What Astronomy has Done for the World," Dr Russell Tracy Crawford, of the University of California, April 15, "Mars," Dr Mars F. Baumgardt, of the Southern California Academy of Sciences

THE recently formed section of hydrology of the American Geophysical Union announces the organization of a committee on the hydrology of glaciers, composed of the following men Dr Stephen R Capps, senior geologist, Alaska branch, U S Geological Survey, Dr Harry Fielding Reid, professor emeritus of dynamic geology, Johns Hopkins University, G L Parker, district engineer, water resources branch, U S Geological Survey, Carl P Richards, chairman of the research committee of the Mazamas, Portland, Oregon, R H Sargent, senior topographic engineer, Alaska branch, U S Geological Survey, Dr Wallace R Atwood, assistant, branch of research and education, National Park Service, François E Matthes, senior geologist, section of glacial geology, U S Geological Survey, chairman The functions of the committee correspond in general to those of the Glacier Commission appointed by the section of scientific hydrology of the International Geodetic and Geophysical Union in Europe and will consist principally in securing systematic records of the annual variations of American glaciers

THE Botanical Society of New Orleans held its first meeting of the season of 1931–32 on October 20 Dr Robert Glenk, curator of the Louisiana State Museum, presented a paper on "Some Facts about Perfume-yielding Plants," illustrating his discussion with slides and with a selected set of specimens of the raw materials representing the basic perfume types The ensuing business meeting dealt principally with the program for the coming year and with plans for the coming New Orleans meeting of the American Association for the Advancement of Science

THE will of the late Senator Dwight Whitney Morrow contains the following provisions (e) To the trustees of Amherst College, a body corporate established by law in the Commonwealth of Massachusetts, two hundred thousand dollars ($200,000) Without limiting such trustees' discretion in their use of this absolute bequest, I here mention my preference that this bequest be added to the general endowment of the college, the income to be applied to the maintenance and, if possible, to the increase of professors' salaries at such college, (f) To the trustees of Smith College, a corporation established by law in the Commonwealth of Massachusetts, two hundred thousand dollars ($200,000), to be part of the endowment funds of such college, (g) To the Smithsonian Institution, city of Washington, D C, one hundred thousand dollars ($100,000), to be part of its endowment funds, (h) To the trustees of Columbia University in the city of New York, fifty thousand dollars ($50,000), to constitute a fund, the income of which is to be applied, from time to time, to the uses and purposes of its School of Law, (i) To the Union Theological Seminary in the city of New York, fifty thousand dollars ($50,000), to be part of its endowment funds

SEVEN members of the privately financed exploration and filming expedition to Colombia and Ecuador, known as the Latin-American Expedition, Inc, sailed on September 26 for Panama on the Grace liner *Santa Maria*, for seven months' intensive research, with Dr Matthew W Stirling, of the Smithsonian Institution, as chief of the scientific division Dr. Stirling is to conduct an investigation at the headwaters of the Magdalena River of the ancient monoliths, which he believes may furnish a clue to the riddle of the migration of the early peoples in the Western Hemisphere It is also planned to explore the Napo River in Ecuador and to study the habits of the Jivarro Indians, who are known as head hunters

DISCUSSION

COURSES ON THE HISTORY OF PHYSICS IN AMERICAN COLLEGES AND UNIVERSITIES[1]

IN 1921 a survey was made of the instruction being given in the history of the sciences in American colleges and universities.[2] Information was gathered by means of questionnaires that had been sent to about four hundred institutions and it was found that there was considerable interest in the historical development of the various branches of science. There were numerous replies expressing the hope that there would be a further expansion of this field of study

---

[1] Read before the Ohio Academy of Science, April 4, 1931.

[2] E. H Johnson, "The Present Status of the History of Science in American Colleges and Universities," SCIENCE, n.s., LVI: pp 585–595, December 16, 1921.

During the decade that now has elapsed, college curricula in general have undergone great changes, and there have appeared many publications dealing directly with the history of science. Hence it has seemed desirable to make a new survey. The present report—dealing only with instruction in the history of physics—is but a part of the yet unfinished study which is to include all of the various branches of science now being taught in American colleges.

This new investigation has been carried out along lines wholly different from those followed in the study of 1921. Only the regular college publications such as catalogues, special bulletins and course lists have been consulted. It was felt that this procedure, while imperfect, would eliminate many of the defects inherent in the questionnaire method.

To date the curricula of 320 of the colleges and universities in the United States have been examined. This number includes the majority of the stronger institutions regardless of the nature of their support, whether state, denominational, non-sectarian or private, also coeducational institutions and those for men or women only. They have a wide geographic distribution. Of this number, 51 are now offering courses on the history of physics as regular, credited units in the curriculum, and there is no indication that in any of these institutions this type of course is being given as anything but a serious and worthwhile study. A little more than half of these 51 institutions are east of the Mississippi River, while 70 per cent. are north of the latitude of that imaginary dividing line associated with the names of Mason and Dixon. Of the southern group, 30 per cent. are in California. In other words, the northern states and California offer four-fifths of the courses on the history of physics now available in the United States. Naturally, coeducational institutions predominate, making 72.5 per cent. of the total, while men's and women's colleges amount to 7.9 and 19.6 per cent., respectively.

Of the 51 institutions considered here, 39 are offering courses strictly limited to the history of physics, while the other 12 give a small part of the time to allied subjects or pedagogic procedures. 13 of the purely physics courses deal with selected, special topics, such as the development and influence of outstanding theories, *e.g.*, the wave theory of light or the rise of the 19th century ideas of the conservation of matter and energy. While the majority of courses include surveys of the growth of physical science from the earliest times, there are a few that deal with the developments of the past twenty-five or fifty years only, taking them up in such a connected, chronological order as to warrant classification as historical.

The forms of instruction differ widely. Probably few teachers of physics have learned much about the origins of their science until after they have passed through their own college training period. Only after becoming specialists have they found time to look back over the field they have entered. Consequently each will develop his own best method of approach in teaching the history of physics. It is not an easy subject to handle adequately, but the task has been lightened somewhat by the appearance during the past few years of several special textbooks, and the number of classic papers available has been increased by numerous reprints and the publication of photographic copies of the originals. In nearly all of the courses examined, the lecture method is prominent. Next come the use of a textbook, and in order of frequency, assigned reading of outside sources and class reports with discussions. In several intitutions classical experiments are repeated as class demonstrations, and in at least one university the students themselves are required to prepare and deliver part of the lectures.

The question of prerequisite subjects is of importance. In a few institutions no requirements are made, but in the majority of cases, one or even two years of college physics are required for admission to classes in the history of physics. Some of the better schools even go further than this, and admit only seniors or graduate students in physics.

It has not been possible to determine the mathematical prerequisites definitely, but a number of colleges do require the calculus. Of course this requirement would be met automatically by all students qualifying where advanced physics courses are demanded.

In practically every case the history of physics is given on the same basis as any other advanced physics elective, *i.e.*, during one or two semesters and receiving from two to four credits towards graduation.

Probably all physics teachers introduce many topics in their regular lecture discussion in their historic sequence. Some of the more recent college physics texts emphasize this historic form of presentation of subject-matter, because their authors feel that it has great appeal and cultural value for the general student, while it supplies a highly desirable background for the specialist.

Reference was made above to the indications of a growing interest in the history of science. German scholars have appreciated the value of this field of study for many years. Only recently has there been any very serious attention given to it in America. But now it is growing and attracting notice abroad. Recently I received a letter from a lecturer at the University of London asking about the general procedure in this country. It showed two things [illegible] clearly: first, that English scholars have a genuine appreciation of the value of the study of the history of the physical sciences, and, second, a recognition of American activity in this same field. Present indications are that the study of this phase of the growth of civilization soon will win an important place in the curriculum of the American college

E. H. JOHNSON

KENYON COLLEGE

A NEW ELM DISEASE

AFTER the identification of the Dutch elm disease in Ohio, during the summer of 1930, some 300 specimens of diseased elm trees were collected or received from correspondents, examined and the fungi in them isolated in cultures at the Dutch elm disease laboratory operated by the Ohio Agricultural Experiment Station and the division of forest pathology, Bureau of Plant Industry, at Wooster, Ohio In these cultures it was found that a certain fungus was present in a little over ten per cent of the cases The past history and the condition at that time of several of the trees from which this fungus was isolated indicated that they were probably parasitized, some dying entirely during the summer of 1930 and others losing part of their tops. On the strength of these observations, soon after growth began this spring, fourteen young elms were inoculated with the fungus

About a month after inoculation, symptoms of disease appeared on seven trees Drooping and wilting of the leaves, preceded or accompanied in most cases by a distinct yellowing was first noted In a short time most of the leaves dropped although some leaves turned brown and remained on the twigs for more than a month. The diseased twigs and branches died as well as the main trunk above the point of inoculation A blackening of the bark, which in a few cases extended directly up the trunk from the point of inoculation, was noted on some trees. Apparently the disease made more rapid progress upward than downward, since the branches below the point of inoculation with a few exceptions remained healthy The entire top of one tree, inoculated at the base, died.

A brown discoloration of the cambium and current growth of sapwood was evident when cross-sections of the diseased branches were examined. The staining in the inoculated trees was more uniform and somewhat more diffused than that found in trees affected with either the Dutch elm disease or Verticillium wilt. However, the discoloration in some cases resembled that of the two latter diseases markedly.

The fungus was reisolated from the inoculated diseased trees but not from inoculated trees which did not develop the disease, although attempts were made to do so. Check trees remained healthy.

On potato dextrose agar the fungus first appears from plantings of diseased wood as a white, cottony colony of aerial mycelium Later it becomes light brown. But one type of spore has been noted in the cultures. They are hyaline, generally elliptic, although the shape is variable, and in most cases contain one or two oil drops. The average size of 50 spores was 1.9 x 4.5 microns Occasionally a group of spores loosely bound together in a small head and borne on the end of a short conidiophore was found. For this reason the fungus is tentatively referred to Cephalosporium. No difficulty is experienced in distinguishing this fungus from *Graphium ulmi* Schwarz Although the spores are about the same size, the type of growth of the colony, its color, and the relatively scant spore production differentiate it from the organism causing the Dutch elm disease

The fungus was cultured from specimens sent to the Dutch Elm Laboratory from Iowa, Missouri, New York and Washington, D C, as well as from various localities in Ohio A more detailed study of the disease and the fungus is in progress

CURTIS MAY

OHIO AGRICULTURAL EXPERIMENT STATION,
WOOSTER, OHIO

THE GALL BLADDERS OF CHICKS IN A VITAMIN D DEFICIENT CONDITION[1]

SEVERAL times during the past few years we have noted in this laboratory that the gall bladders of chicks in a vitamin D deficient condition appeared to be larger than those of chicks of the same age but receiving an adequate supply of this vitamin.

Recently there was an opportunity to make quantitative observations of the gall bladders of two groups of chicks which had been on an experiment from hatching until nine weeks of age Both groups received the same basal ration, which was deficient in vitamin D For Group 1, 1 per cent. of cod-liver oil was incorporated in the ration, but Group 2 subsisted on the basal ration only When the chicks were killed at nine weeks of age leg weakness was quite marked in the latter group, whereas the former was normal. The average weight of the gall bladders of Group 1 (ample vitamin D) was 0 57 gm (P E. ± 0 04) and that of those of Group 2, 1 27 gm (P.E. ± 0.12). When the probable error of the difference between the two means is calculated and compared with the difference, a high degree of significance is obtained. Although accurate measurement of the volume of bile from the two sets of bladders was not feasible, the volume in the case of the deficient chicks was markedly larger than that of the normal chicks. It is significant that although the average body weight of the vitamin D deficient group is approximately 60 per cent of that of the normal group, the average weight of the gall bladders of the former is slightly more than twice that of the latter.

---

[1] Journal Series paper of the New Jersey Agricultural Experiment Station.

Whether the enlarged gall bladder is characteristic of the vitamin D deficient condition or whether it is found in chicks deprived of other dietary factors is not known

WALTER C RUSSELL
DONALD F CHICHESTER
DEPARTMENT OF AGRICULTURAL
BIOCHEMISTRY
NEW JERSEY AGRICULTURAL
EXPERIMENT STATION

A TREMATODE FROM THE CLOACA OF THE GULL

RECENT experiments at the Marine Biological Laboratory, Woods Hole, Massachusetts, have shown that the oyster drill, *Urosalpinx cinereus,* is the snail host of *Parorchis avitus* (Linton 1914),[1] the adult trematode having been originally described from the herring gull, *Larus argentatus* The cercaria was found by Stunkard in the summer of 1930 and a complete description of it has been submitted for publication On account of the resemblance of this larva to *Cercaria purpurae*[2] which has been reported by Lebour and Elmhirst[3] to be the cercaria of *Parorchis acanthus* (Nicoll),[4] it was suggested that the present species might be the cercaria of *Parorchis avitus*

Most of the larvae encyst on the bottom of the dish within forty-eight hours after escaping from the snail They have not been found to encyst in the mantle of *Mytilus edulis,* as reported by Lebour and Elmhirst for the cercariae of *Parorchis acanthus* This gives another specific difference between *Parorchis avitus* and *Parorchis acanthus.* The cysts were fed to tern nestlings which were brought into the laboratory shortly after hatching. Twelve flukes were obtained from the cloaca of a single bird which was killed ten days after the infestation was established. Although the worms recovered were not sexually mature, they were readily identified as *Parorchis avitus,* and this identification has been confirmed by Dr Edwin Linton Experiments are now being made in order to obtain mature worms and to complete the life history by infesting the snail A detailed account of this work will appear at a later date

RAYMOND M CADLE
HORACE W STUNKARD
NEW YORK UNIVERSITY

HYBRID WORDS

"SHAPOMETER" is a good expressive word, and Messrs Tester and Bell are to be commended for disregarding pedantic conventions to secure a good word that suits their purpose If such words are "obvious hybrids, interdicted by good usage," as stated by Mr Dayton in the issue of June 26 (73 704), it is time for scientists, who live in the present and face the future, to change the usage Our language contains far too many words like "morphometer" or "psephometer" formed with undue consideration of a dead language and too little consideration of the needs of a living language and a progressive people The English language would be in better shape if some people knew less Greek and Latin

G S. FRAPS
CHIEF DIVISION OF CHEMISTRY,
TEXAS AGRICULTURAL EXPERIMENT
STATION

REPORTS

GRAVITATIONAL AND ELECTROMAGNETIC FIELDS

PROFESSOR ALBERT EINSTEIN has recently completed a part of his work (in collaboration with Dr Walter Mayer) on the "Unitary Theory of Gravitation and Electricity" It will be published in the near future probably in Pasadena in connection with Professor Einstein's investigations of last winter Meanwhile Professor Einstein has prepared a preliminary announcement for the Josiah Macy, Jr., Foundation, under a grant from which the work was done The statement was prepared by Professor Einstein in German, and the publication in English has been authorized by him. It reads·

> Ever since the formulation of the general relativity theory in 1915, it has been the persistent effort of theoreticians to reduce the laws of the gravitational and electromagnetic fields to a single basis It could not be believed that these fields correspond to two spatial structures which have no conceptual relation to each other. Thus arose the theories of Weyl and Eddington, which, however, have been abandoned by their authors, the theory of Kaluza and also the theory of distant parallelism After we both had worked more than a year on the further development of the last theory, we reached the conclusion that we were striving in the wrong direction and that the theory of Kaluza, while not acceptable, was nevertheless nearer the truth than the other theoretical approaches.
>
> Kaluza's theory rests on the assumption that the

---

[1] *Proc U S Nat. Mus*, 46 551–555, 1914

[2] *Trans Nat Hist Soc.*, Newcastle, n s, 1 437–454, 1907

[3] *Jour Mar. Biol. Ass'n*, Plymouth, n s, 12 829–832, 1922

[4] *Quart Jour. Mic Sci.*, 51: 345–355, 1907.

physical space-time continuum is five dimensional (instead of, as formerly, four dimensional) in which the empiric four-dimensionality of the physical continuum can be accounted for by the hypothesis that the physical variables are independent of the coordinate x_5. By postulating a Riemann metric in five dimensions, Kaluza reaches field laws which agree in first approximation with the known field laws of gravitation and electricity.

Among the considerations which question this theory stands in the first place. It is anomalous to replace the four dimensional continuum by a five dimensional one and then subsequently to tie up artificially one of these five dimensions in order to account for the fact that it does not manifest itself.

We have succeeded in formulating a theory which formally approximates Kaluza's theory without being exposed to the objection just stated. This is accomplished by the introduction of an entirely new mathematical concept which may be described as follows.

Until now it has been believed that one can introduce into a space of n dimensions only vectors or vector fields of which the number of components agrees with the number of dimensions of that space. It appears, however, that this restriction is not necessary. It has its origin in the "anschauliche" significance of those vectors responsible for the formulation of the vector concept. We have been successful in introducing into space R_n of n dimensions, vectors $a^i (i = 1 \ldots m)$ of m components and in deriving a calculus of such vectors and tensors which is essentially no more complicated than the well-known absolute calculus.

Our theory arises quite readily from consideration of five-vectors (five components) in the four-dimensional continuum. There follows from that a "five-curvature" of space which is analogous to the Riemannian curvature, and which bears a similar relationship to the laws of the unitary field that the Riemannian curvature does to the relativistic equations of the gravitational field alone.

This theory does not yet contain the conclusions of the quantum theory. It furnishes, however, clues to a natural development, from which we may anticipate further results in this direction. In any event, the results thus far obtained represent a definitive advance in knowledge of the structure of physical space.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PROTECTIVE COATINGS FOR MINERAL AND ROCK SPECIMENS[1]

A LARGE number of density determinations are made in this laboratory on rock specimens, many of which are very porous and some quite friable. The method used was described by Gealy[2] and consists of measuring the volume of the specimen by noting the displacement of mercury in a Russell tube, the weight of the mass and the volume of the grains. In 1920, Melcher[3] described a method for determining pore space of oil and gas sands in which he coated the specimens with paraffin to prevent loss of material and penetration of the immersion liquid. The amount and volume and density of this paraffin had to be determined and account taken of these factors in computing the pore space of the sand. Furthermore, great care had to be exercised in the application of the paraffin to keep it from penetrating too deeply into the specimen and to prevent or eliminate air bubbles in the paraffin itself which would vitiate volume measurements. Gealy substituted mercury for acetylene tetrachloride in the Russell apparatus in order to eliminate the use of paraffin. However, it was found that even mercury has a tendency to penetrate the very large pores of a rock and often erroneous volume measurements were obtained.

This difficulty has now been overcome by the use of a new protective coating consisting of a solution of ordinary photographic film in butyl acetate. The emulsion is thoroughly cleaned off of used film by digestion in hydrochloric acid. Just enough butyl acetate is used to cover the film and it is set aside in a closed vessel to dissolve. Solution takes place quite slowly. It is necessary to filter, using a suction filter, to obtain a product that is free from strings. When applying the coating of film scrap to a specimen it may be diluted with acetone if necessary. The solvent evaporates very rapidly and seems to leave a plug of film in the outer pores that effectually prevents penetration of a non-solvent liquid. No readily discernible coating is left on the specimen. By trial it has been shown that the volume of the coating can be ignored for all practical purposes since it affects the percentage pore space volume only in the third decimal place.

Another very important and possibly extensive use for film scrap solution, once it is known to scientific men, is in the preservation of museum specimens. A specimen of sandstone that was so friable it could not be touched without considerable loss of material was covered with film scrap applied with a camel's hair brush. In a few moments it was dry and in appearance the coated specimen could not be distinguished from an uncoated one. However, it can now be handled with moderate care and no sand grains are knocked off in the handling. Likewise very fissile shale specimens have been preserved *en masse* for laboratory hand specimens.

---

[1] Published by permission of The Gulf Companies.

[2] W. B. Gealy, Bull. Amer. Assoc. Pet. Geol., Vol. XIII, 1929, Part 1, p. 677.

[3] A. A. Melcher, Trans. Amer. Inst. Min. Met. Eng., Vol. LXV, p. 469.

ROBERT W. CLARK

GULF RESEARCH LABORATORY,
PITTSBURGH, PA.

A SHORT METHOD FOR THE PREPARATION OF ANIMAL TISSUES FOR STAINING

CUT the tissue in pieces from two to four millimeters in thickness. Drop these in some ten per cent. formalin solution and heat to boiling. Transfer them to acetone for dehydration and leave them in this liquid for one hour, during which time the acetone should be poured off and renewed with fresh material two or three times. The dish should be covered and put in the paraffine oven, as diffusion takes place more rapidly at the higher temperature. Remove the tissue from the acetone and drop it into a container of melted paraffine. Leave this in the oven for one hour.

Embed, mount on block and cut in the usual manner. Smear the slides lightly with Mayer's albumen, float the sections over this on a drop of water, warm gently to expand them and drain off the excess.

Lay the slides out flat in the paraffine oven. At the end of one hour remove them. After they have cooled, put them in xylol to dissolve the paraffine and proceed in the usual way to stain and finish them.

Excellent slides have been made by this method. If quicker results are desired, cut the tissue in smaller pieces. If larger pieces must be used, allow more time for the infiltration of acetone and paraffine.

PAUL W. BOWMAN

THE GEORGE WASHINGTON UNIVERSITY

MARK N. LINCH

COLUMBIA HOSPITAL, WASHINGTON, D. C.

SPECIAL ARTICLES

FURTHER EXPERIMENTS ON CORTICO-ADRENAL EXTRACT: ITS EFFICACY BY MOUTH

A RAPIDLY accumulating mass of evidence indicates that extracts of the adrenal cortex which have recently been developed are markedly potent in both experimental and clinical cases of adrenal insufficiency. The methods of Hartman and his associates[1] and Swingle and Pfiffner[2] have been widely used. In experiments reported from this laboratory full support has been given to the observations of the Princeton workers. We have employed a slightly modified Swingle-Pfiffner technique as described.[3]

Cortico-adrenal extract maintains completely adrenalectomized animals in good health for indefinitely long periods. It readily abolishes the severe symptoms of adrenal insufficiency when allowed to develop, and concurrently restores the blood sugar and non-protein nitrogen levels to normal.

Augmentation of the blood sugar to the normal value occurs in adrenalectomized cats showing symptoms within one to three hours after the extract is given. The increase is approximately proportional to the amount of the material injected; it is produced consistently and repeatedly when potent extracts are used. We have observed the effect at least five times within about ten days in the same adrenalectomized animal.

Cats with severe symptoms of adrenal insufficiency invariably show low blood sugar values. In over thirty cases in our experience, cortico-adrenal extract has raised the sugar percentage to within normal limits or higher. Notable increments in blood sugar also occur in unoperated cats, particularly if young animals are used. Biological assay of the extract based on the observed blood sugar effects is suggested from these results.[4]

The decreases in blood non-protein nitrogen, following extract injection, have not been so characteristic in our experiments. They usually occur more slowly than the glycemic changes, and sometimes are long delayed. These differences are possibly referable to the renal condition (damage?) in the different animals, and also to the fluid content of the tissues. In some cases there is considerable urination following extract administration.

Intraperitoneal injections of pituitrin, ephedrine and ergotamine solutions, known to influence the blood sugar in insulin hyperglycemia and other conditions, do not affect significantly the low blood sugar levels or the symptoms of adrenal insufficiency.

The administration of cortico-adrenal extract has been tested by mouth in a series of animals. The large doses which were found to be necessary, and the relatively small supplies of the extract available, as well as the considerable expense of the material, has somewhat curtailed our observations. Cats have been kept alive by oral treatment, however, for two weeks *after* severe symptoms (convulsions) of adrenal insufficiency became evident. Death rapidly followed withdrawal of the extract. Complete recovery from the convulsions which usually immediately preceded death was readily brought about, in several cases in the same animal.

---

[1] F. A. Hartman, K. A. Brownell and W. E. Hartman, *Amer. J. Physiol.*, 95: 670, 1930.

[2] W. W. Swingle and J. J. Pfiffner, *Amer. J. Physiol.*, 96: 153, 1931.

[3] S. W. Britton and H. Silvette, SCIENCE, 73: p. 322, March 20, 1931; *Ibid.*, p. 373, April 3, 1931; *Amer. J. Physiol.*, 97.

[4] S. W. Britton and H. Silvette, *Amer. J. Physiol.*, in press.

The low blood sugar, high non-protein nitrogen and increased blood cell volume are restored to within normal limits when the extract is given by mouth All the effects which were produced by oral administration were in keeping, indeed, with those which resulted from intraperitoneal injection of the material Approximately three to five times the intraperitoneal dosage was necessary to produce comparable results It is definitely clear from the experiments, however, that the effective hormone of the adrenal cortex is not wholly if at all destroyed in its passage through the gastro-intestinal mucous membrane

Numerous attempts to maintain the lives of adrenalectomized cats by feeding whole and demedullated adrenal glands have not to date been successful The animals do not readily eat the glandular tissue, if they are forcibly fed, vomiting often follows

Adrenalin given by mouth in similar concentration to that present in the cortical extract which was used had no noteworthy influence on adrenal insufficiency Glucose solutions given orally were also without significant effect

The development of a method by which potent extracts of the adrenal cortex can be consistently produced suggested that tests of extracts of other tissues be made Knowledge that specific chemical agents or hormones may be separated from widely different body tissues, and also that certain characteristics of the adrenal cortex find a resemblance in other extra-adrenal tissues (*e g*, the brain and testes), gave some hope of success in these experiments Extracts were made of the following tissues testes, brain, liver, spleen, and heart muscle The method of preparation of these extracts was in all details similar to that used concurrently in making potent preparations of the adrenal cortex When the tissue extracts were tested on adrenalectomized cats showing different degrees of adrenal insufficiency, however, the results were in all cases wholly negative No effects were observed on the muscular weakness or other symptoms, or on the length of survival after operation

In a recent report[5] the striking influence of cortico-adrenal extract, in bringing about precocious sexual maturation in rats, has been pointed out Maintenance of the lives of adrenalectomized animals and the effects on sexual maturity—two apparently widely-separated functions—which are brought about by cortico-adrenal extract indicate the presence in the material of two distinct chemical agents or hormones.

It is suggested that the primary action of the life-preserving hormone of the adrenal cortex, which is effective in conditions of adrenal insufficiency, is concerned with preservation of the normal carbohydrate balance in the body

Observation that animals from which the adrenal glands have been completely removed may be kept alive with extracts of the cortex indicate the dispensability but not the inutility of adrenal medullary secretion

Summary

Increase of the blood sugar which invariably follows administration of cortico-adrenal extract to adrenalectomized cats with symptoms of insufficiency is a reliable index of potency and affords a means of bio-assay of the material

Cortico-adrenal extract is effective when given by mouth The lives of adrenalectomized animals are prolonged and all the signs and symptoms of severe insufficiency are rapidly abolished by oral administration of large doses of the extract

Extracts which have been prepared similarly to cortico-adrenal extract from many different (extra-adrenal) body tissues have no influence on the symptoms of adrenal insufficiency

The existence of two hormones in cortico-adrenal extract is postulated

S W Britton
H Silvette[6]

University of Virginia

VARVED CLAY IN HOLMES COUNTY, OHIO[1]

In the course of field study of the glacial geology of Holmes County, Ohio, several deposits of layered glacial clay and silt have been discovered

Holmes County is in northeast central Ohio The region is one of maturely dissected upper Mississippian (Waverley) and Lower Pennsylvania (Pottsville and Allegheny) horizontal sediments The usual relief is about 300 feet The Late Wisconsin drift border crosses the county in a general east-west direction, except in the eastern portion, where the glacial boundary trends northeast-southwest The farthest extent of the Late Wisconsin ice sheet is not well marked by a terminal moraine, except in some of the valleys which have their courses across the glacial boundary

---

[5] E. L. Corey and S. W. Britton, Science, 74 101–102, July 24, 1931.

[6] W T Porter Fellow in Physiology.

Grateful acknowledgement is made of aid received in the above investigations from the Grants-in Aid Committee of the National Research Council

[1] Published by permission of the Director, Geological Survey of Ohio.

Evidence is accumulating to show that the ice front retreated unevenly Ice remained in the valleys for some time after it had melted from the hilltops Such a condition was favorable for the formation of temporary lakes, not only in northward flowing valleys, but also in valleys flowing southward

One of the lake deposits made up in part of varved clay is in southwestern Paint Township, in northeastern Holmes County, in the upper end of the valley of Middle Fork of Sugar Creek.[2] A well marked flat, now somewhat dissected by gullies to a depth of about 20 feet, is present on either side of the Mt Hope-Winesburg road, two miles east of the first named village The top of the terrace is approximately 1,110 feet above tide. A section of the material at the top of the terrace, measured in a newly excavated road-bank two miles east of Mt Hope shows the following

	Ft	In
Fine gravel	3	0
Sand	0	10
Sand and clay layers, fairly even, each layer about ½ to 1 inch thick	6	0

A short distance to the northwest, along a side road, about 10 feet lower than the deposits above, layered material resembling varved clay is present. It consists of evenly bedded sand layers about ¼ inch thick and layers of soft, soapy, bluish gray clay from 1 to 1½ inches thick The clay layers contain thin streaks of sand about 1/64 inch in thickness The clay layers can be separated along the thin sand partings

Another deposit of layered clay was laid down in the southwestern part of Section Four, the southeast corner of Section Five and the northern part of Section Nine, Salt Creek Township, in the head of the valley of a small stream flowing southwest to Martins Creek[3] This deposit is cut by the stream The area is covered by irregular deposits of sand and gravel, giving a hummocky expression to the valley filling The gravel and sand were probably washed into the lake after the deposition of the underlying clay and deposited around ice blocks Along the road in central northern Section Nine, 20 feet of varved material is exposed It consists of horizontal layers of clay and fine sand. The clay layers vary in thickness from ¼ to ½ inch, and the sand layers from one to two inches.

About three fourths of a mile to the northeast, in the southeastern part of Section Five, the relationship of the lake deposit to the underlying till is shown by the following section·

	Ft.	In
Clay and sand layers, clay layers the thicker	7	0
Gravel, small pebbles	1	5
Boulder clay, yellow, containing cobbles to 6 inches	2	3
Boulder clay, hard, tough, grayish blue, silty	25	4

Some poorly exposed layered silt occurs in the valley of Martins Creek, one mile southeast of Benton, Salt Creek Township,[3] at an elevation of approximately 1,020 feet To the northwest of Benton, kame terrace gravels overlie sand in which stratification is not well developed

Layered clay is associated with the kame terrace on the eastern side of Killbuck Valley in the northern part of Millersburg, the county seat[3] Clay four feet thick overlain by six feet of gravel is exposed at the end of North Grant Street It is made up of layers ½ to ⅜ inch thick, separated by sand layers about 1/16 inch in thickness The banding of this deposit may not be seasonal

It is hoped that other deposits will be found and that sufficient data can be secured to correlate the deposits A study of the till, and of the valley gravels, mainly of kame terrace type, is also in progress.

George W White

Department of Geology,
University of New Hampshire,
Durham, N H

---

[2] Shown on the Millersburg and Navarre topographic sheets of the United States Geological Survey.

[3] Millersburg sheet.

BOOKS RECEIVED

Academia Pro Interlingua. Key to and Primer of Interlingua Pp v + 168 Dutton

Comstock, Anna B *Handbook of Nature-study.* Twenty second edition Pp xvii + 942 1,000 illustrations Comstock Publishing Company. $5 00.

Ford, E B *Mendelism and Evolution.* Pp ix + 116. Dial Press $1 50

Gallaudet, B B *A Description of the Planes of Fascia of the Human Body* Pp 75 6 figures Columbia University Press $2 00.

Guyer, Michael F *Animal Biology.* Pp xi + 744. 409 figures Harper & Brothers $3 75

Hirsch, Nathaniel D Mttron *Genius and Creative Intelligence* Pp 339 Sci-Art Publishers.

Hopkins, B Smith and Harvey A. Neville. *Laboratory Exercises and Problems in General Chemistry* Revised edition Pp. xi + 164 26 figures. D C. Heath $1 76

Howard, Albert and Yeshwant D Wad. *The Waste Products of Agriculture.* Pp. xiv + 167. 14 plates. Oxford University Press

Liu, J. C *Systematic Botany of the Flowering Families in North China.* Pp. xxxiii + 213. 294 figures. Henri Vetch, Peiping, China $5.00.

McDowell, S A *Biology and Mankind.* Pp x + 229 45 figures. Macmillan. $2 50.

Reed, W. Maxwell. *The Stars for Sam.* Edited by Charles E St John Pp viii + 190. 108 plates. Harcourt, Brace $3 00.

Strong, Edward K. *Change of Interests with Age.* Pp. 233 Stanford University Press $4.00.

Williams, Samuel H. and Robert T Hance. *Laboratory Exercises in General Zoology.* Pp. ix + 209. Illustrated Harper & Brothers. $2.50.

SCIENCE

Vol. 74 FRIDAY, NOVEMBER 6, 1931 No 1923

A Study in Biokinetics PROFESSOR CHARLES D SNYDER .. 443

Obituary
Memorials, Recent Deaths 449

Scientific Events
Appropriations for Grants in Aid by the National Research Council, The National Advisory Committee for Aeronautics, The Dohme Foundation and National Fellowships at the Johns Hopkins University, The Lowell Lectures 450

Scientific Notes and News 452

Discussion
A Forgotten Contribution to Nutrition by Magendie DR FRANKLIN C BING *A Proposed Classification of Disease Transmissions by Arthropods* DR CLAY G HUFF *Glauconite and Foraminiferal Shells* FREDERICK A BURT *Peat Under a Delaware Beach* DR. LAETITIA M SNOW 456

Special Correspondence
A Flora of Mexico DR S F BLAKE 458

Scientific Apparatus and Laboratory Methods
A New Micromanipulator DR ETHEL MCNEIL and J E GULLBERG *A Singing Tube* PROFESSOR WILLIAM R. COLE *Pure Smooth and Rough Colony Types at Will* AGNES J QUIRK 460

Special Articles
Heterothallism in Puccinia Triticina DR. RUTH F ALLEN *The Redia of the Gasterostomes* DR. A E WOODHEAD *Variations in the Evening Primrose Induced by Radium* WILLIAM H BRITTINGHAM 462

Science News . 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal

Lancaster, Pa Garrison, N Y.

Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

A STUDY IN BIOKINETICS

By Professor CHARLES D SNYDER

DEPARTMENT OF PHYSIOLOGY, SCHOOL OF MEDICINE, THE JOHNS HOPKINS UNIVERSITY

I IS THERE A STANDARD UNIT OF MEASURE FOR PHYSIOLOGICAL ACTIVITIES?

No biologist will deny probably that the conceptions of the cell and gene as biological units have been of great value in the understanding of development, growth and heredity of living things. These concepts are doubtless as fundamental and indispensable to the morphologist as the concepts of molecule and atom are to the chemist. However, in the field of physiology, the aim of which is function rather than form, one seeks in vain for a unit of similar significance The reason for this lies partly in the lack of control, and, if not in control, in the statement of experimental conditions.

For example, if one wishes to gather from the literature on heart metabolism the determinations of carbohydrate and oxygen consumption and to reduce them to a common basis for comparison, one finds the task almost hopeless. For some one or another important condition or factor of the experiment has usually been omitted in the report The results may be given in grams or cc per unit of time, but the rate of beat, or the maximum tension exerted, or the weight of the contracting mass, or the temperature has not been definitely stated How then is one to compare the metabolism of one heart with that of another, to say nothing of a comparison of the metabolism of heart muscle in general with that of skeletal and smooth muscle? If a number of reliable observations, say, on the carbohydrate and oxygen consumption of the various kinds of muscle could be reduced with certainty to the weight of these substances used up per gram of muscle, per gram tension exerted, per single contraction, one would begin to feel that one had the materials for a search for a common standard of measure of muscle activity, and indeed a promise of finding a common standard of measure for all vital activities; the point being that a smallest unit of vital activity first must be recognized and agreed upon, and second that the observed metabolic changes are reducible to that unit On such a basis the possibility can not be excluded that ultimately physiologists may find a reliable yardstick for the final comparison of any one with any other elemental physiological process—a unit of measure that will serve finally even in the analysis of the more complicated mechanisms

It should be noted at the outset that this unit is no philosopher's concept of an *élan vital*, or an *entelechie* —of a vague but indispensable essence of *bios* On the contrary, it must express definitely the energy of the smallest activity that can be recognized and agreed upon as physiological, as peculiarly living, as opposed to the activity of non-living matter

If such a standard does not exist or defies analysis and definition it would seem that we shall be obliged to abandon for all time any hope of carrying our analysis and description of the physiology of living matter much beyond the point where we have now arrived

Modern physiologists thus far have been quite content, and rightly so, whenever they have been able, to take the measure of a living process in terms of the units set up as standard by the physicist and chemist For the most diverse phenomena of the non-living world have been brought together under increasingly inclusive concepts and thus have been expressed in more comprehensive units of measure Indeed it is a striking fact that the physicist and chemist have been able to arrive at their most far-reaching generalizations only in so far as they have been able to marshal their specific measurements under broader and more inclusive standards of measure In his preliminary study, therefore, the physiologist perhaps can do nothing better than to inquire as to how far he is able to marshal the diverse and special measurements of various living processes similarly under broader and more inclusive standards And if these more inclusive standards turn out to be also merely the standards set up by the physicist, he still may feel justified in having made the attempt and in believing that the goal of standard unit of physiological activity has been brought thereby somewhat nearer to realization Accordingly what follows in the present paper consists of a preliminary examination of the field to that end

II. ON THE NATURE OF EXCITATION

All physiology may be defined simply as a study of stimulation and response of living matter But stimulation is the process of arousing a state of excitation at a given point, and since all response is preceded and accompanied by physiological excitation our definition may be simplified further by saying that all physiology is a study of the excitation of living matter. Is there any property or process common to all the manifold forms of excitation, of conduction and response, that physiologists thus far have studied? The answer to this question is decidedly yes. For in every case where the tissue can be tested by appropriate experiment the excitation aroused by a stimulus has been found to be accompanied by an electrical disturbance, long known as the "action current," more lately referred to as the "action potential" both phrases leaving the word "electrical" to be inferred. This is true not only for the immediate region of excitation, the receptor or sense organ, but for the conducted wave of excitation be it along a nerve fiber or over a muscular organ, or any other excitable tissue Just recently this electric change has been observed for single muscle and nerve fibers and finally for a single sensory-end point such as the so-called muscle spindle. There can be no doubt that it will be demonstrated finally for such excitations as the contraction of the vorticella stalk and of a single flagellum of the flagellates.

The newer physics teaches us that the setting up of a difference of electrical potential is due to the pressure of negatively charged particles called electrons, that the electrical current is a transfer, or a flow of these electrons in one direction and that the free electrons move with great speed in an oscillatory or vibrational manner

Excitation of living matter therefore must be at bottom a tearing loose and transfer of electrons. How is it possible for the many varied forms of stimulation (which we know are able to excite living matter) to excite electrons? For the answer we must examine the various forms of external stimuli themselves. When this is done it is found that they also are vibrational in character, molar, that is made up of molecular vibrations in the case of mechanical, sonic and auditory stimuli, and thermal stimuli when these are due to conducted heat. In the case of electricity and radiated heat, in short, in case of all forms of radiant energy that serve as adequate stimuli to living matter, these all are obviously vibrational in character These widely different forms vary in wave-length from nearly two meters to a fraction of a mm (as in the case of mechanical and sound stimulations) to the exceedingly short wave-length of the visible, ultra-violet and Roentgen rays. How can stimuli of such various wave-lengths set up electron transfers?

Before answering this question it is worth while noting that, so far as we know, living matter is not stimulated by radiant energy of all wave-lengths; for example, the Hertzian, or "radio" waves, the electromagnetic waves and the shortest of all known, the cosmic rays, produce no stimulation It will be noted that some of these non-stimulating waves have longer, some shorter, wave-lengths than, say, the visible which probably affect all forms of life. In other words, there are not only islands of deafness in certain ears but in all living matter there are islands of irresponsiveness to certain groups (or octaves) of the great keyboard of vibrational energy

The explanation of this is given with the answer as to why living matter is excited at all by any vibrational energy Clearly this must be because living matter contains resonators or "detectors" that "synchronize" with certain wave-lengths and thus excite electrons in the living body Hence we have the "action currents," the "action potential" in the living body accompanying all forms of excitation, that is all forms of effective stimulus and response.

An effective and adequate stimulus, therefore, must be vibrational in character But before leaving this definition it should be pointed out that one other characteristic is also a *sine qua non.* There must be a certain suddenness in the change, a certain minimal rate of change, in the intensity of the external stimulus This explains further, perhaps, why living matter is insensible to certain forms of radiant energy mentioned above We can move from the dark into the light but when do we ever move out of or into the terrestrial field of magnetism? These magnetic waves are all-pervasive and their rates of change in intensity are of the slowest The cosmic rays likewise are always with us at the same intensity so far as we know Living matter has had no occasion to develop appropriate resonators to detect them and would have no use for them if it did.

All living matter is at times irritable, and sensory end-organs are only masses of living matter specially organized in different ways to exhibit extreme degrees of irritability, that is, to play the rôle of resonators to changes in intensity of various forms of vibrational energy.

We now then begin to perceive what some of the conditions of a living tissue must be when in a state of irritability. Irritability requires a difference of electrical potential set up between the two sides of an interface in such a state of equilibrium of surface forces as to be vulnerable to a sudden change of certain vibrational intensities. When this latter effects an electron transfer, then an adequate stimulus results, the action potential is observed, the excited state is set up, in some cases propagated, and finally motor end-organs are likewise excited.

From what has been said in the foregoing section it no longer appears unreasonable that, at least in some of the physiological processes, we are dealing with radiational forms of energy and electron transfers. If this is the case then the question becomes pertinent: Do any of the laws of radiation, as developed by the modern physics, hold in the case of such physiological activities? Before answering this question it is in order first to make a brief statement of such laws and equations as will be made use of in the answer

III. Laws of Radiation and Biological Processes

The law of equivalence as formulated by Einstein states that for every molecule or atom undergoing change in photochemical reaction one quantum of radiant energy, $h\nu$, is absorbed If q' represents the total absorbed light energy in terms of ergs, and N the total number of molecules or atoms engaged in the reaction then

$$(1) \qquad q' = Nh\nu, \text{ ergs}, \text{ whence } q'/Nh\nu = 1$$

This equation has been verified for certain photochemical reactions. For certain other photochemical reactions, where the equation does not appear to hold directly, reasons have been given to show that the observations dealt not with the primary photochemical reaction but with "secondary" and even "chain" reactions; indeed in several of the exceptional cases, in which the primary action was finally found, the law of equivalence was also found to hold At the present time it is said the law of equivalence has been found to hold for some 28 photochemical reactions; there are a number in which the primary action has not yet been discovered.

Stark in 1908 first gave evidence that such a law existed for photochemical reactions and Einstein, of relativity fame, put the equation on a firm theoretical basis (1912) The physicist, E Warburg, (1912–14) gave the first complete experimental proofs that the law holds, work that was promptly followed by numerous other confirmatory experiments during the score of years that now have intervened The physical-chemists were interested from the beginning, and to some of them, notably Bodenstein, Trautz (1904–1918), Haber, C M Lewis and Perrin (1919), among others, it occurred that if photochemical reactions are a function of the frequency of the effective visible and ultra-violet wave-lengths then it may be that thermochemical reactions are likewise a function of the frequency of the respective wave-lengths that lie in the infra-red portion of the spectrum

The equations expressing the relation between temperatures, heat of activation and velocity of reaction for ordinary chemical processes, that go on independently of light, had been determined long before, but now it was advocated, *for instance*, that an equation expressing the relations in a thermochemical reaction based upon the laws of radiation was nothing more or less than that of the well-known equation expressing the velocity of a reaction as influenced by temperature. Thus it was pointed out by M. Trautz and by J. Perrin that the equation

$$(2) \qquad \ln K = \frac{h\nu}{k}\left(\frac{T_1}{1} - \frac{T_2}{1}\right)$$

(in which K is the velocity of the reaction, ν, the frequency of the effective wave-length, k and h, radiation constants, T_1 and T_2, temperature in degrees absolute) is practically nothing more or less than the van't Hoff equation,

$$(3) \qquad \ln K = \frac{q}{2}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

in which q in terms of calories of heat (instead of $h\nu$ in terms of ergs) is the critical increment of energy required per gram-molecule of the chemical substance activated

Now this q factor of equation (3) has been a subject of study for a number of years by both chemists and physiologists, for obviously it can be determined if *one only observes the velocities of the reaction* (k) at different temperatures The physiologist reasons that if q represents the amount of energy required per gram-molecule of substance undergoing chemical change in a purely chemical reaction, then likewise q determined from the observed velocities of certain biological processes at different temperatures will also represent the required energy per gram-molecule undergoing *chemical change in the living body*, even though just what the chemical change is, may not be known

Do the q′ and q terms of the two equations, (1) and (3), stand essentially for one and the same thing? Are they equal and interchangeable? Theoretically in (1) q′ is the total increment of energy required for activation of a gram-molecule of substance undergoing photo-chemical reaction while in (3) q is the total increment in energy required for activation of a gram-molecule of substance in a thermochemical reaction Is the energy here involved in the form of radiant heat or of conducted heat? Increase of temperature involves an increase in the speed of motion of the molecules of the body heated, causing increased number of molecular impacts and bombardments Arrhenius considered this but could not find enough energy from this effect to account for the enormous influence that a rise of temperature has upon the velocity of reaction and rejected it as an inadequate explanation of the phenomenon[2a] This forces one to turn to the radiant aspect of the heat for an explanation

The champions of the radiational hypothesis of thermal-chemical activation, therefore, believed themselves justified in assuming that the jump in the frequencies from the lower to the higher temperatures represents a critical increment of energy in the sense of that phrase as used by the exponents of the radiational theory of photochemical reactions, and that actual electron-transfers thus are effected in the thermal as well as in the photochemical reactions If so, then q′ and q of equations (1) and (3), if not equal, can be made so by introducing a correcting factor, as Perrin, among others, did and as appears in the constant of equation (2)

According to Wien's law of displacement, wave-length and therefore frequency of radiant energy, is a function of the temperature and expressed by the equation,

$$(4) \qquad \lambda\mu T = b$$

But, $c/\lambda\mu = \nu$, *and therefore the law of equivalence* as expressed in equation (1) may be put as

$$(5) \qquad q' = NhCT/b, \text{ where}$$

N is Loschmit's number, or the Avogadro number, $= 6\ 06\ \ 10^{23}$
h is Planck's radiational constant, $= 6\ 55\ \ 10^{-27}$,
C is the speed of light in μ, $= 3\ \ 10^{14}$, and
b is the constant in Wien's law, $= 2882$

When the constants in (5) are put in a single figure, we have

$$(6) \qquad q' = 41\ 2\ \ 10^7\ \ T \text{ ergs}$$

For those chemical reactions and for those physiological processes, that are influenced by temperature in their rates of reaction, it has become customary to reduce the observed results of observations to a common standard, that is, to a temperature coefficient for differences of ten degrees, expressed with the symbol, Q_{10} If Q_{10} is known for a given process the determination of q is simplified For, from equation (3) it follows that in the special cases where the velocities of reaction are k_2 and k_1 at temperatures T_1 and T_2, when the latter are 10 degrees apart, $k_2/k_1 = Q_{10}$ Then, introducing the necessary modulus to convert natural into Briggsian logarithms and also the factor $4\ 19\ \ 10^7$ to convert calories into ergs, equation (3) becomes

$$q = \log\ Q_{10}\ \ 4\ 57\ \ \frac{T\ (T+10)}{10}\ \ 4\ 19\ \ 10^7 \text{ ergs}$$

By taking a temperature that is median to T and T + 10 (say, Tm) we have an approximation equation out of (3) where

$$(7) \qquad q = 1.915\ \ 10^7\ \log\ Q_{10}\ \ T^2_m \text{ ergs}$$

But Q_{10} varies between 2 and 3 for the most part. If we put $Q_{10} = 2\ 5$, then equation (7) takes the special and simple form of

$$(8) \qquad q = 0.761\ \ 10^7\ \ T^2 \text{ ergs.}$$

[2a] But see also the papers of K F Herzfeld, *Ann der Physik*, 1919, vol. 59, p 635, and *Zeitschr f Physik.*, 1922, vol 8, p 132.

The Einstein photochemical equation in the form of (6) may now be compared easily with the van't Hoff-Arrhenius thermodynamical equation in the form of (8)

Physiological reactions among the cold blooded animals proceed mostly between 5 and 25 degrees C, and in this range, even for one and the same reaction, Q_{10} may vary from 3 to 2 Below I have tabulated the values of q in terms of 10^{11} ergs as calculated from the photochemical equation (6) and also from the thermodynamical equation (7) In both cases the calculation is made for the median temperatures, at which the corresponding values of Q_{10} are sometimes found, and on the assumption that a purely radiational effect could be had at the infra-red frequencies represented by the given temperatures In the last column the ratio of q/q′ is given for each of the temperatures, from definition this is also the value of q/Nhν

TABLE 1

T_m, degrees absolute	Q_{10}	Energy in terms of ergs/10^{11}		$\frac{q}{q'}$
		q	q′	
283	3 0	10 66	1 164	10 94
288	2 5	6 31	1 180	5 33
293	2 0	4 69	1 206	3 85
303	1 0	0	1 249	0

It is quite obvious thus that in this range of temperature q in the thermodynamic equation varies greatly, that is, roughly as the square, or as the logarithm, of the temperature coefficient (when this latter varies), whereas q′, as determined from the photochemical equation, varies just linear with the temperature The table finally shows that, when $Q_{10} = 1$, then $q = 0$, whereas q′ is still in quite linear proportion to T This simply emphasizes the point that in purely photochemical reactions a rise of temperature (in the sense of heat conducted to the system, which latter thereby becomes a warmer body) has no effect whatever on the reaction

When biologists began to point out that those physiological processes having a temperature coefficient lying between 2 and 3 were probably processes primarily dependent upon chemical reactions, the objection was raised that such was not necessarily the case because some (photochemical) reactions have their $Q_{10} = 1$. This argument led these critics into the fallacy of implying that, because some chemical reactions are not influenced in their rates by temperatures, those reactions that are so influenced can not be chemical reactions!

But let us take a case where the temperature coefficient is nearly constant throughout the range of temperature employed in the foregoing table, say $Q_{10} = 2.5$ Putting q and q′ again in terms of ergs/10^{11} we see that the q values vary with the temperature in the same linear fashion, as do the q′ values

TABLE 2

T_m	q	q′	q/q′
278	5 88	1 144	5 14
283	6 06	1 164	5 21
288	6 31	1 186	5 33
293	6 54	1 206	5 42

In table 1, last column, one sees that the ratio q/q′ also tends to be constant

This ratio shows that when $Q_{10} = 2 5$ the energy involved in the thermodynamic equation is some five times greater than that involved in the radiational equation Does this mean that in the former reaction there are some five quanta of the infra-red radiations absorbed per molecule that undergoes chemical transformation? Or does it mean that the chemical reaction can be accelerated merely by the increase in the rate of molecular impacts? In this latter case, then, it takes five times the energy when applied in the form of molecular impacts to do what is accomplished when the energy required is all in the form of radiant energy There is still the possibility that a combination of both forms of energy is involved when $Q_{10} > 1$, where q′ parts of q are supplied by radiations (increase in electronic frequencies) and $q - q'$ of the energy is supplied by molecular impacts This brings the discussion to a point where a physiologist can not carry it further to any advantage and where the interested reader would more profitably consult such works as the reports of the Symposia on Radiation,[1] and Tolman,[2] where one also will find references to the literature Brief review and fuller citation of the literature by the writer,[3] will also be found in a recent article of which this paper is a brief summary and continuation Let us rather turn our attention to a few specific cases of physiological processes

IV. Analysis of Physiological Processes

The phenomenon of photosynthesis in green plants is one that involves the problem stated above and probably the studies of O Warburg[4] and of O Warburg and Negelein[5] will be most useful as illustration. In these studies the amounts of carbonic acid assimilated by the action of light on a suspension of the one-celled alga, *Chlorella,* were observed The light used was of certain selected wave-lengths whose intensities as well as the amounts absorbed by the cells were measured In the later work the results lead the authors to conclude that photosynthesis in *Chlorella* does not follow directly the law of equivalence, for not one quantum but from 4 to 5 quanta of light energy were found to be absorbed per molecule of carbonic acid assimilated, about 4 quanta for red or yellow light, 5 quanta for blue light

---

[1] See *Chemical Reviews*, 1928, vol v, p 39; and 1930, vol. vii, pp 203–258

[2] R. C Tolman, "Statistical Mechanics with Applications to Physics and Chemistry," N Y, 1927, pp 276–285.

[3] C. D. Snyder, "Quantitative Relations in Biological Processes and the Radiation Hypothesis of Chemical Activation," *Quar. Rev of Biology*, 1931, Sept. number [in press].

In the earlier work Warburg reinvestigated what is known as the "Blackman reaction" which refers to the Blackman's observations that the rate of photosynthesis at the higher of the ordinary light intensities is influenced by temperature somewhat to the same extent as are the usual chemical reactions, with temperature coefficients greater than 2, at the least effective intensities of light, however, Q_{10} approaches unity as is the case with many photochemical reactions *in vitro*

Now it is just this Blackman reaction that illustrates a case where both thermal and photochemical reactions are known to be combined in a living process, and a survey of the results of Warburg are of the greatest interest In table 3 the present writer has added certain quantities to Warburg's results (which are there reproduced) that can be calculated on the basis of the equations given in part I of this paper, namely the q value from the temperature coefficients, *i e*, the "heat of activation," according to the thermodynamic equation (7) but in terms of calories; and finally the ratio of the value of q to the (theoretical) radiant thermal energy per gram molecule of carbonic acid assimilated at the several mean temperatures, and as calculated in calories according to equations (1) and (6)—in short the q/q′ or q/Nhν ratios

TABLE 3

THE HEAT OF ACTIVATION IN TERMS OF QUANTA FOR PHOTOSYNTHESIS IN CHLORELLA AFTER THE DATA OF O WARBURG

Temp range, deg C	5–10	16–25	5 4–10	10–20	20–30	15–25	25–32
Rel intensity of light	16	16	45	45	45	1 8	1 0
Q_{10}	4 8	2 0	4 3	2 1	1 6	1 06	1 00
q = heat in cal / 1000	24 50	11 57	22 70	12 40	8 26	1 11	0
q/Nhν = quanta per molecule CO_2 ..	8 8	4 0	8 2	4 36	2 88	0 384	0

From this table it may be seen at once that for weakest effective intensities of light (I = 1 0) the value of Q_{10} is unity, that is, a rise of temperature from 25° to 32° has no effect on the reaction, q, and accordingly q/Nhν, that is the thermal quanta yield becomes zero But for the higher intensities Q_{10} increases until it becomes more than 4 for the low temperature ranges and is about 2 for the more usual temperature ranges experienced normally by the active cells. "Heats of activation" thus appear and when put in terms of thermal quanta vary from 2 88 to 8 0 per molecule of CO_2 assimilated But it is to be recalled that from 4 to 5 quanta of light energy also are absorbed independently of the temperature, in which case it further appears that when the greater intensities of the light are employed and at different temperatures, the total of thermal and photo-radiational quanta involved in the synthesis must vary from 7 to 13 It will be noted further that the thermal quanta, for the more moderate temperature ranges and the higher intensities, are 4 0 and 4 36 respectively. This is also about the yield in thermal quanta that can be calculated from the rate of oxygen absorption by green plants in the dark, as observed by Mattheis (1904) and Yabusoe (1924) That is, carbonic acid production (or the reverse process of carbonic acid assimilation) involves about the same number of thermal quanta as the number of light quanta that are involved in carbonic acid assimilation. Further, the quanta yield in all cases lies between 4 and 10 as was shown must be the case (see table 1) for the vast majority of physiological processes influenced by temperature

The part of the studies on *Chlorella,* however, that seem to be of greater interest, because less complicated, is that where it was shown that independently of temperature, and when the light intensity is low, the quanta yield is 4 to 5 per molecule of carbonic acid assimilated This yield is striking when compared to the (thermal) quanta yield of those simpler physiological processes that are influenced in their rates by temperature but not at all by light.

The transmission of nervous excitation is such a process Dealt with statistically, as was done in the former paper previously referred to on this subject,[3] the temperature coefficients for the more moderate range of temperature vary between 1 90 and 2.38 for frogs' motor nerve. These values give quanta yields, varying from 3.97 to 5.18 per molecule of whatever substance may be responsible for the transmission of excitation in nerve. In other words, the number of quanta is about the same for a relatively simple physiological process influenced only by heat as it is for an equally simple physiological process that is influenced only by visible light radiations, that is, for carbonic acid assimilation by the green plant when the intensity of the incident rays is weak

---

[4] O Warburg, *Über die Geschwindigkeit der photochemischen Kohlensäurezersetzung in lebenden Zellen. Biochem Zeitschr* 1919, vol 100, p 230

[5] Warburg und Negelein, *Über die Energieumsatz bei der Kohlensaureassimilation Zeitschr f. physikal. Chemie*, 1922, vol. 106, p 191

Putting these facts together it seems that the cogency of the problem set forth is established and that there can be no escape from the surmise that the frequency of dark-field radiations in a purely thermal process may play the same rôle that the frequency of visible radiations plays in a purely photochemical process.

This being the case then it would seem that the surmise could be put to the test of experiment by exposing a system, whose reaction is susceptible to thermal changes, to direct infra-red radiations This indeed has been done by chemists and from their experiments no clear proof has yet been established that absorbed infra-red radiations affect the rate of chemical reaction [1] However, it would seem that this does not exclude the possibility that with the discovery and application of new methods, the proof may yet be brought forth

At the same time there is also the possibility that the application of heat to these "thermal systems" brings about radiation among the molecules themselves, that is, the increased force of molecular impacts may produce perturbation among the outer sphere of electrons of atoms, which leads to electron transfers. The atoms themselves thus become sources of radiation, the processes of emission as well as absorption all occurring within the system itself That this is possible is suggested by the phenomena of chemiluminescence and bioluminescence whereby the application of a variety of external agents, none of which need be primarily radiant energy, the atoms or molecules within the system are brought to a state where they themselves become the source of visible light. If atoms and molecules can thus be made to emit visible radiations it would seem to be all the more probable that they oftener and more easily can be made to emit radiations of lower frequency, that is, infra-red radiations. But such radiations being invisible will be all the less easily demonstrated. Especially must this be the case where the emitted radiations are also absorbed by the same system. Here the chances of detection by a dark-field radiometer obviously become nil [6]

V Summary

In the foregoing pages the writer has attempted to point out first, the importance to physiologists of the discovery and application to their problems of a unit of physiological activity to serve as a universal measure of life processes Second, a survey of the field of excitation and response points to the probability that electron transfers are involved in every case and, therefore, that such a standard of measure, if ever determined, will probably involve terms of radiational units Third, a brief statement of some of the laws of radiation that seem to be involved is given, together with a sketch of the radiation hypothesis of chemical thermal reaction Fourth, an analysis of the data of a few physiological processes is then presented, the results of which strongly suggest the possibility that the influence of temperature upon living processes may be due to dark-field radiations quite as much as the photochemical effects in living processes are due to radiation of visible light

OBITUARY

MEMORIALS

Under the leadership of Reginald P Bolton, a committee has been organized to raise a fund of $25,000 to preserve the home of John James Audubon in New York City. It is planned to move the house to a city park to be used as a public museum

A fund is being collected in the Canal Zone for the purchase of an oil painting of General George Washington Goethals, to be hung in the administration building at Balboa Heights It will be painted by Brigadier General Chester Harding, retired, a former governor of the Canal Zone, who, since leaving the service, has renewed his portrait studies in Paris.

Nature reports that a fête in honor of Henri Moissan was celebrated on October 4, in the cathedral town of Meaux, situated on the banks of the Marne. The delegates were received on October 3 at the Ministry of Foreign Affairs on the Quai d'Orsay, and on the following morning nearly three hundred were taken by special train to Meaux The ceremonies included the formal presentation to the Communal College (of which Moissan was a pupil from 1864 until 1870) of a plaque on the wall of the entrance hall, and in the afternoon the unveiling, by Mme. Jean Gerard, of a monument in a small square by the side of the town hall The monument is in the form of an obelisk, from the upper part of which the features of Moissan emerge from the solid stone, while on the side are sculptured diagrammatic representations of his electric furnace and of the apparatus with the help of which he isolated fluorine, with quotations from his writings Discourses were delivered under the direction of Professor Behal, representing the minister of public instruction The first three were by the president of the organizing committee, by the mayor of Meaux, and by the president of the old students' association of the College of Meaux, the others were by M Lebeau, the assistant and colleague of Moissan, representing the friends and students who had worked in Moissan's laboratory, by Professor Honigschmid, of Munich, who was a former student of Moissan, on behalf of the foreign delegates and by Professor Behal on behalf of the government

---

[6] For a full presentation of the physical aspects of the topics dealt with in this paper see vol. 23, *Handbuch der Physik*, 1926, edited by Geiger; especially chapters 5, 6 and 7 by Pringsheim, Noddack, and Franck and Jordan, respectively

RECENT DEATHS

DR SAMUEL RAYNOLDS PARSONS, professor of physics at the University of Arkansas for the last eight years, died on October 10 He was forty-three years of age

DR JAMES SIMPSON CHESTER WILLS, metallurgical engineer, at one time adjunct professor of analytical chemistry at Columbia University, died on October 29, aged eighty years

DR SAMUEL MATHER, pioneer in the development of the iron mining and steel industries and the Great Lakes shipping fleets, has died at the age of eighty years

DR JOHN J DUNPHY, specialist in pediatrics and instructor of pediatrics at the Harvard Medical School and Tufts Medical School, died on October 13 at the age of thirty-eight years

MR JAMES LONG, formerly professor of dairy farming at the Royal Agricultural College in Cirencester, died on October 1. Mr Long was eighty-five years of age

MR J W TAYLOR, of Leeds, England, known for his work on conchology, died on September 2 at the age of eighty-seven years

THE death is announced of Dr Josef Bayer, director of the division of anthropology and prehistory in the State Museum of Natural History in Vienna, and editor of the journal *Eiszeit*

PROFESSOR GUIDO HOLZKNECHT, head of the Vienna Roentgen Institute, died on October 30 at the age of sixty years

SCIENTIFIC EVENTS

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AT its meeting in October the National Research Council's committee on grants-in-aid made grants for the support of research as follows

To Thomas B Brown, professor of physics, George Washington University, cathodofluorescence, E Hobart Collins, professor of physics, Parsons College, the resonance radiation of mercury

To H F Moore, professor of engineering materials, University of Illinois, the effect of repeated stresses on nickel-chromium steels under high temperatures

To W L Beuschlein, professor of chemical engineering, University of Washington, the hydrogenation of coal in various dispersion media, Richard Bradfield, professor of soils, and W G France, professor of chemistry, Ohio State University, size distribution in soil particles, Samuel C Lind, director of the school of chemistry, University of Minnesota, the chemical reactions produced in gases and other dielectrics by passage of electrical discharge, James W McBain, professor of chemistry, Stanford University, development of an ultra-centrifuge

To Harold L Alling, professor of geology, University of Rochester, the optical properties of feldspars, Julia Gardner, geologist, U S Geological Survey, Eocene faunas of northern Mexico; Elbridge C. Jacobs, professor of geology and mineralogy, University of Vermont, installation of a seismograph at the University of Vermont, E M Kindle, chief, division of paleontology, Geological Survey of Canada, a bibliographic index of North American Devonian fossils, Asa A Lee Mathews, assistant professor of geology, Oberlin College, Paleozoic stratigraphy and paleontology of Giles County, Virginia, Joseph T Singewald, Jr, professor of economic geology, the Johns Hopkins University, petrographic investigations of rock specimens from the Andes of central Peru

To J McA Kater, assistant professor of zoology, Washington State College, the functional significance of mitochondria, Reginald D Manwell, assistant professor of zoology, Syracuse University, avian malaria; W D Salmon, research professor of animal nutrition, Alabama Polytechnic Institute, the relation of vitamin B to carbohydrate metabolism; Bruce Webster, assistant professor of medicine, Tulane University School of Medicine, the nature of a goiter-producing substance found in cabbages

To Alan A Boyden, assistant professor of zoology, Rutgers University, serological study of the early development of the chick; E B Copeland, research associate in the department of botany, University of California, the Old World species of the fern genus *Trichomanes;* Berwind P. Kaufmann, professor of botany, University of Alabama, chromosome structure in several plant genera; Harold Kirby, Jr., associate professor of zoology, University of California at Berkeley, protozoa of termites; C. L. Turner, professor of zoology, Northwestern University, fishes of the Mexican plateau.

To J. E Coover, professor of psychology, Stanford University, analysis of expert performance in typing, Warren K. Moorehead, director of the department of archeology, Phillips Academy (Andover), classification of stone-cutting tools of the American Indians of the United States and Canada; S. L Pressey, professor of educational psychology, and L. C Pressey, assistant professor of educational psychology, Ohio State University, emotional attitudes and interests among certain tribes of American Indians; Ruth Sawtell Wallis, assistant professor of sociology, Hamline University, cranial types of western Europe

VERNON KELLOGG,
Secretary

THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

ACCORDING to the *U S Daily*, facilities of the Langley Memorial Laboratory of the National Advisory Committee for Aeronautics were made available to members of the nation's aircraft industry on October 22 when the committee at its regular annual meeting passed a resolution favoring such action

Use of the laboratory for test purposes will be permitted, providing the individual pays the expense, the resolution provided. This action was taken, it was explained orally at committee headquarters, in order that test projects not of general interest to the industry, yet capable of being carried out only at the Langley laboratory, might be conducted for the benefit of individual manufacturers

Results of such experimental and test work will be turned over to the person requesting the test, it was agreed, but in the discretion of the committee may also be published for general distribution

Rear Admiral William A. Moffett, chief of the bureau of aeronautics, Department of the Navy, extended the committee an invitation to inspect the new naval airship *Akron*. Considerable research work on airships was conducted by the National Advisory Committee for Aeronautics at Langley Field in conjunction with building of this dirigible.

The committee also adopted a testimonial resolution on the death of Dr. Samuel W Stratton, late president of Massachusetts Institute of Technology, former director of the Bureau of Standards, one of the three organizers of the committee and a member of the research group since its formation

Dr. Joseph S. Ames was reelected as chairman and Rear Admiral David W. Taylor (retired) as vice-chairman. The executive board which was elected consists of Dr Ames, Admiral Taylor, Dr. Charles G Abbot, Dr George K. Burgess, Major General James E. Fechet, Mr William P MacCracken, Jr, Brigadier General Henry C Pratt, Admiral Moffett, Captain Arthur B Cook, U S N., Mr Edward P. Warner and Mr Orville Wright

THE DOHME FOUNDATION AND NATIONAL FELLOWSHIPS AT THE JOHNS HOPKINS UNIVERSITY

IN the first lecture of the 1931–32 series under the Dohme Foundation, given at the Johns Hopkins University on October 23, Dr Leo Hendrik Baekeland, honorary professor of chemical engineering at Columbia University, addressed the faculty and students of the department of chemistry Under the title, "My Mistakes," the lecture dealt with the fortunate accidents which have contributed to Dr Baekeland's long and successful career in chemical research and industry, describing from the speaker's personal experience the adjustments that must be made by a man who carries the spirit of pure research into the industrial field

The lecture was followed by a dinner given in honor of Dr. Baekeland by the students under the national fellowship plan, in connection with which the Dohme Foundation lectures are conducted This furnished the first occasion of the academic year for a formal gathering of these students, who now number thirty-one The new incumbents of national fellowships are· Philip G. Ackerman, from Oregon State Agricultural College, on the American Can Company fellowship for Oregon, C. Gerald Albert, from Yale University, the Mary Carroll Garvan memorial fellowship for Connecticut, R. Keith Blakely, from the University of New Mexico, the Chemical Foundation fellowship for New Mexico, Kenneth W. Brighton, from the University of Utah, American Can Company fellowship for Utah, Harold G Burman, from Dakota Wesleyan University, Chemical Foundation fellowship for South Dakota, Lawton A. Burrows, from Drury College, William R Warner and Company fellowship for Missouri, Clayton W. Ferry, from the University of North Dakota, John M Hancock fellowship for North Dakota, William P. Hall, from Occidental College, American Can Company fellowship for California, Arnold L Lippert, from the University of Illinois, Central Scientific Company fellowship for Illinois, Robert J Myers, from Creighton University, Cudahy Packing Company fellowship for Nebraska; James L. Nauman, from Cornell College, G. A. Pfeiffer Company fellowship for Iowa; Charles C. Rainey, from Emory University, Coca-Cola Company fellowship for Georgia.

Subsequent lecturers for this year under the Dohme

Foundation are scheduled as follows: Dr C. F. Kettering, of the General Motors Corporation, Detroit, Michigan, Dr Julius Stieglitz, of the University of Chicago; Dr James F Norris, of the Massachusetts Institute of Technology, Dr Gilbert N. Lewis, of the University of California, Dr Irving Langmuir, of the General Electric Company, Schenectady, N Y., Professor Alfred Stock, of the Technische Hochschule, Chemisches Institut, Karlsruhe, Germany, and Professor Simon, of the University of Breslau

THE LOWELL LECTURES

The Lowell Institute program of free public lectures for 1931–32, the ninety-second year of the Boston foundation, is announced by President A Lawrence Lowell, trustee, and Professor W H Lawrence, curator The lectures began on October 26, and will end during the latter part of March.

According to a statement in the Boston *Evening Transcript*, there are nine courses scheduled, a total of sixty-one lectures, or about the usual number The opening date is nearly four weeks later than the opening of the season of last year and two weeks later than the season of two years ago Five of the lecturers are coming from abroad and two are from Harvard University

The first course, to be given on Mondays and Thursdays at five o'clock in the afternoon, began on Monday October 26 It is by Dr F van Bemmelen, formerly professor of zoology at the University of Groningen, the Netherlands, on "Color and Shape in the Living World" The topics are as follows

1 The Development of the Color Pattern and the Veins on the Wings of Butterflies

2. The Relations of Skin-Design between Caterpillar, Pupa and Butterfly.

3. A Natural Explanation of the Origin of Mimicry in Butterflies

4 The General Plan of Skin Design in Mammals

5 The Phenomenon of Second Self in Man, Explained by Heredity of Family Likeness

6 The Heredity of Curly Hair in Man, Studied by Means of Portraits

7 The Ancestral Table and the Parentela the Two Principal Methods for the Study of Human Family Descent

8 Sexual and Asexual Propagation, in Their Relation to the Cell Theory

Second on the list is a course of six lectures with illustrations by Dr W de Sitter, director of the observatory and professor of astronomy at the University of Leiden, on "The Development of our Insight into the Structure of the Universe" This course will be delivered on Tuesdays, Fridays and Saturdays at 8 P M, and began on Tuesday, November 3. The topics are as follows

1 Aims and Methods of Scientific Research The Ancients Ptolemy and Copernicus

2 The Birth of Modern Astronomy Kepler, Galileo, Newton The Eighteenth Century

3 The Beginning of Sidereal Astronomy William Herschel and His Successors

4 Further Observational Advances The Survey of the "Local System" Lifework of J C Kapteyn

5 Photography and Spectroscopy The Great Telescopes Extragalactic Systems

6 Relativity and Modern Theories of the Universe.

SCIENTIFIC NOTES AND NEWS

The Nobel Prize in medicine and physiology for 1931 has been awarded to Professor Otto Warburg, head of the department of biology of the Kaiser Wilhelm Institute, for his work on cellular metabolism

The Perkin Medal Committee of the American section of the Society of Chemical Industry has awarded the Perkin Medal for 1932 to Dr Charles F Burgess, of the Burgess Laboratories, Madison, Wisconsin, for his achievements in the field of electrochemistry The medal will be presented to Dr Burgess at a meeting in New York on January 8

Masani Nagata, the Japanese melon farm foreman and amateur astronomer, has been awarded the Donohoe Comet Medal by the Astronomical Society of the Pacific for his discovery last July.

Dr. Waldemar C Brøgger, professor emeritus of geology at the University of Oslo, Norway, will celebrate his eightieth birthday on November 10.

Dr H Foster Bain, who resigned recently as secretary of the American Institute of Mining and Metallurgical Engineers to become managing director of the Copper and Brass Research Corporation, received a gold watch from the officers and directors of the institute at the monthly dinner and meeting of the New York section at the Hotel Commodore on October 28 The speakers included Mr J V W. Reynders and Mr E DeGolyer, past presidents of the institute, Mr A B. Parsons, the incoming secretary, and Dr Bain.

After a letter from Lord Beauchamp to the University of London Graduates' Association announcing his resignation as chancellor of the university had been read at a meeting of the council, it was resolved unanimously to invite Lord Moynihan, president of the Royal College of Surgeons of England, and a graduate of the university, to accept the association's nomination for the office of chancellor.

Dr. F N Guild, for thirty-four years professor of mineralogy at the University of Arizona, has retired from active work and has been made professor emeritus of optical mineralogy

A division of graduate study, coordinate with the other major divisions of the institution, has been established at the Kansas State College of Agriculture and Applied Science Dr James E Ackert, professor of zoology and since 1923 chairman of the graduate council, has been made dean of the new division

Dr Horace B English, formerly professor of psychology at Antioch College, has been appointed professor of psychology at the Ohio State University

Miss Katherine Haring, of New Haven, Connecticut, a graduate of the class of '29 at Mount Holyoke College, has become the recipient of the Loomis fellowship of $1,500 in chemistry at Yale University Miss Haring is the first woman to receive this fellowship, which is made on the basis of the results of two years of graduate work.

The Mellon Institute of Industrial Research announces the foundation of an industrial fellowship by the Green Bag Cement Company of Pittsburgh, a subsidiary of the Davison Coke and Iron Company The investigational work of this fellowship, which will be carried on by Mr Raymond C Briant, will be concerned with studies of the chemical and physical properties of Portland cement and with the development of certain new cement products

Dr Walter B Carver, professor of mathematics at Cornell University, will become editor-in-chief of the *American Mathematical Monthly,* beginning in January, 1932

Dr. Clarence O Cheney, formerly superintendent of the Hudson River State Hospital at Poughkeepsie, N Y, has been appointed director of the New York State Psychiatric Institute He succeeds Dr George H Kirby, who recently retired

Dr. Guy R Stewart has been appointed senior forest ecologist with the U S Forest Service, and is attached to the Northeastern Forest Experiment Station at Amherst, Massachusetts He is project leader on an ecological study of the factors associated with the success or failure of forest plantations in the northeastern United States

Dr. George Grant MacCurdy, director of the American School of Prehistoric Research, represented Yale University at the celebration of the fiftieth anniversary of the opening of the Natural History Museum Building, held in the museum, South Kensington, London, on September 29 and 30, 1931.

Dr. John Rice Ball, associate professor of geology and paleontology in Northwestern University, is spending a sabbatical year abroad He will devote a large part of his time to a study of the Silurian formations and to the museums which contain considerable collections of Silurian fossils.

Dr. Worth H Rodebush, professor of physical chemistry at the University of Illinois, recently returned from a summer trip through Europe Most of his time was devoted to visiting universities in Germany and other countries

Dr. Matilda Moldenhauer Brooks, research associate in biology at the University of California, has returned from the South Seas, where she spent several months on scientific research under a grant from the Bache fund of the National Academy of Sciences

In announcing in Science for October 16 the appointment of Dr Louis B Slichter, of the California Institute of Technology, as associate professor at the Massachusetts Institute of Technology, it should have been said that it was of geophysics in the department of geology

On October 18, at the Auditorium Hotel, Chicago, Dr E H Volwiler, chief chemist of the Abbott Laboratories and former chairman of the Chicago section of the American Chemical Society, was guest of honor and speaker of the evening at the regular monthly dinner meeting of the Chemistry and Physics Society of De Paul University Dr Volwiler selected for his topic "Chemistry and its Relation to Medicine"

Dr E D Adrian, fellow of Trinity College, Cambridge, and Foulerton research professor of the Royal Society, will deliver the second Harvey Society lecture at the New York Academy of Medicine, on November 19 His subject will be "The Messages in Sensory Nerve Fibers"

The twelfth Pasteur lecture of the Institute of Medicine of Chicago will be given on November 27, at the City Club, Chicago, by Dr Rufus I Cole, director of the Hospital of the Rockefeller Institute for Medical Research Dr Cole will speak on "The Nature of Pneumonia"

Dr. Willem de Sitter, director of the Leiden Observatory, gave a series of three lectures at the University of Pennsylvania, on October 19, 20 and 21, on "The Extent of the Universe" These lectures were made possible by the Tobias Wagner Fund, devoted to lectures on astronomy Dr de Sitter delivered an address on "The Origin of the Planetary System" at a joint meeting of the Washington Academy of Sciences and the Society of the Sigma Xi in Washington on October 26.

THE Mineralogical Society of Southern California was formed recently and held its first meeting on June 23 at the Pasadena Library, with an attendance of 175. The following were elected to hold office until June, 1932 *President,* Mr John A Renshaw, *vice-president,* Mr W S Morton, *secretary,* Mr Edwin Van Amringe, *treasurer,* Miss Helen Fowler

A SYMPOSIUM on poliomyelitis, sponsored by the New York state department of health and a group of pediatricians from New York State and adjacent territory in Canada, will be held in the auditorium of the College of Pharmacy, in Albany, on Thursday, November 12, at 10 00 A M The program, which was arranged by Dr H L K Shaw, program chairman for the pediatricians, and Dr Thomas Parran, Jr, state commissioner of health, will include addresses by a number of experts in poliomyelitis control and research Among the speakers are Commissioner Parran, Dr Lloyd W Aycock, director, Harvard Infantile Paralysis Commission, Dr George Draper, professor of clinical medicine, Columbia University; Dr William H Park, director, bureau of laboratories, New York City department of health, Professor J G FitzGerald, director, Connaught Laboratories, University of Toronto, and Dr Simon Flexner, director, the Rockefeller Institute for Medical Research In view of the recent epidemic of poliomyelitis and the wide-spread interest it aroused, it is believed that this symposium will be of special value in summarizing present knowledge of the various phases of the subject The district consultants in poliomyelitis, health officers and physicians are cordially invited to attend

SECRETARY OF AGRICULTURE ARTHUR M. HYDE was the principal speaker and guest of honor at the opening of the Florida Citrus Products Laboratory of the Bureau of Chemistry and Soils at Winter Haven on October 23 The buildings, grounds and certain other facilities required for the station were furnished by the citrus interests of Florida, in accordance with a proviso in the appropriation act which provided federal funds for the laboratory's work The laboratory was dedicated at a luncheon given by the city of Winter Haven and its chamber of commerce Representative H. J Drane, of the first congressional district of Florida, presided. Following the address by Secretary Hyde, addresses were made by Dr. Henry G Knight, chief of the U S Bureau of Chemistry and Soils, Dr W W. Skinner, assistant chief of the chemical and technological research unit of the bureau, and Dr. F C Blanck, chief of the food research division of the bureau The department officials explained the functions of the laboratory and the relation of the research work of the department to the citrus industry.

THE eleventh annual meeting of the highway research board, National Research Council, will be held on December 10 and 11, in Washington, D. C. The meetings will be in the auditorium of the National Academy of Sciences. The sessions will be devoted to discussions of reports of research activities in relation to highway finance, transportation, design, materials and construction, maintenance and traffic.

AN International Federation of Societies of Tropical Medicine and Hygiene has been organized in Paris The president is Professor C Achard, and the secretary general is Dr M Zeitoun This federation is intended to include the societies of tropical medicine and hygiene throughout the world and is for the purpose of collaboration and coordination of study and research in these subjects Colonel Charles F Craig, professor of tropical medicine and director of the department of tropical medicine at the School of Medicine, at Tulane University, of Louisiana, has been elected a member of the international council of the federation and secretary general of the commission for scientific study of tropical diseases. The American Society of Tropical Medicine has been invited to become a member society of the international federation

IN recognition of its work in forest research, the school of forestry of the University of Idaho has been elected to membership in the International Union of Forest Research Organizations. Notification came from Dr Sven Petrini, the secretary-general at Experimentalfaltet, Sweden. The International Union was established in 1929 and has as its aim the promotion of international cooperation in the various branches of forest research. It comprises more than 80 forest research organizations in 30 countries. Seven other institutions in the United States in addition to the Idaho School of Forestry now belong to the union.

COLBY COLLEGE has received $250,000 under the will of Professor Julian D. Taylor under the condition that the college raise the balance of a $3,000,000 fund.

DAMAGES of $390,000 have been awarded the trustees of Boston University for the taking of about 130,000 feet of land along the Charles River, Bay State Road and Chilmark Street, Boston, for the purpose of building a state highway along the river bank. A jury in the Suffolk Superior Court made the award.

THE committee on drug addiction of the National Research Council has granted the sum of $14,220 for research work to be conducted at the University of Michigan during the present academic year. This is an increase of $4,990 over the amount allocated for

1930–31. The work is to be carried on as previously under the direction of Dr C. W. Edmunds and Dr Nathan B Eddy.

THE government of Manitoba has awarded a contract for the erection of the new science building of the University of Manitoba. A Winnipeg firm of contractors is to construct the building at a tendered price of $536,197 for all stone construction

THE new Harvard astronomical observing station will be built on the highest point between Mount Wachusett and the sea, on Oak Ridge, Harvard, Massachusetts, twenty-seven miles northwest of Cambridge The land was given to the university by Mr and Mrs Alfred C Fuller, of Belmont. Construction will begin early in the spring, according to an announcement by Dr Harlow Shapley, director of the observatory At this station the new 60-inch reflector telescope, the largest astronomical instrument in the East, will be the most important part of the equipment Five or six of the observatory's other photographic telescopes will also be moved from Cambridge to the new station.

A MODERN dormitory for animals has been completed at Wellesley College. In the new zoology unit there is a fully equipped vivarium, containing airy rooms for the small animals and capacious aquariums and frog and turtle tanks. The animal rooms are separate, insuring complete seclusion From each room a trap door leads to an outside runway, and these inclosures are separated from each other by concrete walls that extend eight feet underground to prevent burrowing Each room has two doors, one of glass, the other of wire The floors are of tile and the walls of concrete, to insure sanitary living conditions There is a small kitchen where the animals' food is prepared The department has its own greenhouse in which to raise fish foods and plants for the lice used in experiments. Everything has been done to assure the comfort of the animals while they are awaiting experimentation. The vivarium has eight small aquariums, open on three sides, and two large ones, open on all four sides For the fish that need fresh water, lake water has been pumped from Lake Waban. Salt water has been stored in the basement for the ocean fish.

ACCORDING to a press report, Dr. George Gaylord Simpson, head of the Scarritt Patagonian expedition, returned on October 28, on the Munson liner, *American Legion*, after an absence of more than a year spent studying fossil mammals in the lower region of Patagonia Although some of the specimens had been sent up previously for mounting at the American Museum of Natural History, Dr Simpson said that others would be forwarded later by the government of Argentina. Dr. Simpson left New York in August, 1930, but only seven months were devoted to collecting specimens, as he had spent several months lecturing at the museum in Buenos Aires Dr Simpson was accompanied on the expedition by Mr Coleman S Williams of the museum staff, who returned to New York a few weeks ago The area traversed by the expedition included 5,000 square miles inland from the base camp at Commodoro Rivadavia, which was reached by oil tanker from Buenos Aires

AN expedition in the interest of fifteen small museums, of which Captain Harry Carpelan is in command, sailed from New York on October 1 The expedition is to cost more than $330,000 and is to be financed by a group of wealthy persons from various parts of the United States The cruise will be made in a four-masted schooner with auxiliary motors The itinerary will include Porto Rico, Haiti, the Galapagos, the Marquesas, Samoa, Society and other Pacific islands, Australia, New Caledonia, the New Hebrides, Dutch New Guinea, Borneo, Java, Sumatra, Siam, French Indo-China and the Hawaiian Islands. The voyage will end in Los Angeles in 1933 Those to make the trip, numbering about thirty-five, include several anthropologists, an ornithologist, an ichthyologist, an oceanographer, a zoologist, a sculptor, several painters, photographers and sound-motion picture operators. One representative will be sent by each of the museums to participate

EXPLORATION work by Mr A F Moore, of the Astrophysical Observatory, Smithsonian Institution, who is in South West Africa studying sky conditions, has been hindered by many obstacles. The *U. S Daily* states that Mr Moore spent about two weeks on the summit of Lord Hill, about 60 miles east of Keetmanshop, South West Africa Employing instruments for measuring atmospheric humidity and intensity of solar radiation, he has made daily observations, making notes also of the visible appearance of the sky Great difficulties have been encountered. Mountains there are inhabited only at their bases, where natives live. In their upper regions they are trackless and nearly inaccessible, in some cases rising almost perpendicular, making ascent almost impossible. The observatory's permanent observation peak in that country is Mount Brukkaros. Mr Moore plans to record observation conditions on other peaks, compare them to those on Brukkaros, with a possibility of finding a better observation station. On Lord Hill, Mr. Moore finds that the haze and dust seldom reaches the summit, and as a result, observations may be made when they would be impossible from a lower elevation. Lord Hill is more than 7,000 feet high. After he has worked in the Lord Hill district, Mr. Moore will go north to Windhoek, visiting Mounts Brandberg and Gansberg on his return to [illegible]

DISCUSSION

A FORGOTTEN CONTRIBUTION TO NUTRITION BY MAGENDIE

McCAY[1] has called attention to the hitherto little recognized feeding experiments of Magendie in 1816, in which that noted physiologist tried to demonstrate the importance of nitrogenous foods in the diet The criticism applied to some of Magendie's work has been its lack of completeness It is of interest, therefore, to note that the distinguished teacher of Claude Bernard performed further nutrition investigations that supplement and extend the knowledge derived from his early failures to maintain dogs on rations of isolated materials These additional and practically forgotten experiments in some respects exceed in value the later and more celebrated contributions of the gelatine commission, of which Magendie was chairman Although, strangely enough, this work is not quoted in the gelatine report it is described in all but the first editions of the "Précis Elémentaire de Physiologie" The experiments are also discussed by Londe[2] and Johannes Muller[3] The story may be retold as it could have been read nearly a hundred years ago in the American edition of Magendie's text-book[4]

> Since the publication of these facts (the experiments of 1816), in the first edition of this work, I have observed others not less important, which show how limited our knowledge still is on the subject of nutrition
>
> A dog was allowed to eat pure wheaten bread and drink common water at will He died within fifty days, with all the signs of marasmus in the highest degree
>
> Another dog ate exclusively *military* or *munition* bread, his health continued perfectly good
>
> Rabbits or Guinea pigs fed with a single substance, as wheat, barley, oats, cabbage, carrots, etc, will die, apparently from inanition, within a fortnight, and sometimes much sooner But if the same substances be given together, or after short intervals, the animals live, and do well.
>
> I fed an ass on dry rice, and afterward boiled it in water, because he refused the first, the animal lived only fifteen days The last days he constantly refused to eat the rice A cock was fed on boiled rice for several months, and preserved its health
>
> Dogs fed exclusively with cheese, and others with hard eggs, lived for a long time, but became weak and emaciated, lost their hair, showing imperfect nutrition
>
> . The most general and important consequence deducible from these facts, and which ought to be followed up and examined, is, that diversity and multiplicity of aliments is a very important hygienic rule This is indicated by our instincts, and the variations that the seasons bring in the nature and kind of aliments.

While the precise duplication of Magendie's experiments might prove difficult and while failure to eat in some instances masked the effects produced by the diets, yet in general, the qualitative results are such as might be expected from the standpoint of our modern knowledge Magendie's interpretations are particularly skilful The author indicates a rational solution to the practical problems of nutrition and yet recognizes that the field is just being opened From the historical aspect we may credit Magendie as being one of the first physiologists to use rodents for nutritional investigations The plan of the experiments described shows that he must have realized that the nutritive requirements of different species may vary Finally, in view of our present data on the phenomena of dietary deficiencies in animals, his observation, that prolonged consumption of poor diets might result in loss of fur and in general emaciation, is peculiarly significant One is almost tempted to say that Magendie observed, thereby, some of the signs of vitamin G deficiency in his dogs fed on eggs or cheese alone.

FRANKLIN C BING
DEPARTMENT OF BIOCHEMISTRY,
SCHOOL OF MEDICINE,
WESTERN RESERVE UNIVERSITY,

A PROPOSED CLASSIFICATION OF DISEASE TRANSMISSIONS BY ARTHROPODS

THE diseases which are transmitted by insects and other arthropods often are classified according to the causative organism, and sometimes according to the transmitting agent Each classification serves definite purposes I should like to propose a classification based upon the type of transmission which occurs, not with the idea of attempting to supplant either of the systems of classification already established, but rather with the hope that this one will supplement and probably clarify the others

The nearest approach to such a classification is the well established use of the terms "biological" and "mechanical" in connection with transmission by arthropods These words have served a purpose, but they are inadequate for clearness It is also true that authors are not in agreement as to their exact meanings. The transmission of malarias by mosquitoes is certainly biological. The transmission of anthrax and surra in cattle by blood-sucking flies is mechanical. In many cases the classification of the transmission is not so easily made, and authors classify them in one group or another depending upon their conception mainly of what constitutes a biological transmission. Unfortunately, some writers have interpreted biological to mean cyclical, that is, that the parasite concerned undergoes morphological change in the transmitting arthropod. It seems obvious, however, that at least two biological events may occur in the life of a parasite during its sojourn in the invertebrate host. It may multiply, or it may undergo cyclical change. Other changes are conceivable, but as yet not demonstrated. The four combinations which may be made of these two biological events are given below, together with the names being proposed for the type of transmission represented by the combination.

---

[1] C. M McCay, "Was Magendie the First Student of Vitamins?" SCIENCE, 71 315, 1930

[2] C Londe, "Note sur les Alimens," *Arch gén de Méd*, 10 51–66, 1826

[3] J Muller, "Elements of Physiology," transl by W Baly, American ed by J. Bell, Philadelphia, p 333, 1843.

[4] F Magendie, "An Elementary Treatise on Human Physiology," transl by J. Revere, New York, p. 485, 1845.

	Multiplication of organism in vector	No multiplication of organism in vector
Cyclical change of organism in vector	I Cyclo-propagative Example: Malaria by mosquitoes	II Cyclo-developmental Example: Filaria by mosquitoes
No cyclical change of organism in vector	III Propagative Typhus by lice	IV Mechanical Typhoid by flies

It will be noted that the older term, biological, can still be retained as a collective term for types I, II and III in contrast to type IV, for which I have retained the old term, mechanical. The classification proposed is, then:

Diseases Classified According to Type of Transmission

A. Biological
  - I Cyclo-propagative—the organisms undergo cyclical change and multiply.
  - II Cyclo-developmental—the organisms undergo cyclical change but do not multiply.
  - III Propagative—the organisms undergo no cyclical change, but they multiply.

B. IV Mechanical—the organisms undergo neither cyclical change nor multiplication.

It is, of course, difficult to classify all arthropod-borne diseases on such a scheme. The transmission of relapsing fever by ticks is very probably propagative, but since it is believed by some authors that the spirochaete undergoes a change in morphology in the tick, it is possible that this transmission may be cyclo-propagative. Also, some diseases may fall into two (or possibly more) classifications. The transmission of bubonic plague may be propagative, since we know that the causative organism can multiply in the fore-gut of the flea, and also possibly mechanical, by the direct passage of the organisms in the feces of a flea recently fed on an infected rat. However, it is believed that these cases do not lessen the value of the classification.

When the diseases of man are tabulated according to this scheme, certain facts stand out prominently which were previously obscure or unobserved. For example, it is found that a relatively small group of diseases is transmitted mechanically by arthropods. Also, when one looks for those diseases of greatest importance he finds them in groups I and III. The one characteristic, then, which they have in common is their ability to multiply within their arthropod hosts. The possible exception to this statement is the case of filariasis. However, the difficulty which this disease has in spreading is well known, and must certainly be attributed largely to the fact that the filarial organism does not multiply in its vector. The fact that the most important arthropod-borne diseases of man have one thing in common suggests that more emphasis should be placed upon investigating this common characteristic, that is, toward discovering what factors are concerned in determining whether a parasite can or can not multiply in its invertebrate host.

Clay G. Huff
University of Chicago

GLAUCONITE AND FORAMINIFERAL SHELLS

In the issue of Science for July 3d, A. L. Dryden, Jr., makes some statements relative to the occurrence of glauconite in fossil foraminiferal shells. The writer has been studying the mechanics of concretion development in fossil-bearing concretions from the Cook Mountain (Eocene) formation of Brazos County, Texas. This formation carries large amounts of glauconite, but the observations recorded below were made wholly on the glauconite found within the concretions. The figures are from counts made on

TABLE I

Type of occurrence	Number
Irregular, free, unpolished glauconite grains	126
Thoroughly rounded and polished, free glauconite grains	1911
Empty foraminiferal shells	21
Foraminiferal shells packed with glauconite	189
Foraminiferal shells packed with a mixture of glauconite and other mineral matter	57

TABLE II

Ratio of total free glauconite grains to total grains occupying foraminiferal shells	8.28 to 1
Ratio of foraminiferal shells packed with glauconite to shells packed with a mixture of glauconite and other mineral matter	3.33 to 1
Ratio of total packed foraminiferal shells to empty shells	11.10 to 1

petrographic thin sections cut from parts of 14 concretions. The grains recorded as "polished" are either circular or elliptical in section If they were originally formed in the interiors of the foraminiferal shells the shells had been entirely removed and the grains rounded prior to their inclusion within the concretions

FREDERICK A. BURT

A AND M COLLEGE OF TEXAS,
COLLEGE STATION, TEXAS

PEAT UNDER A DELAWARE BEACH

THE article by Dr Richards on the occurrence of sod under the New Jersey beaches, which appeared in SCIENCE for June 19, interested me very much Similar material was found in 1911 on the beach at Rehoboth, Del This was reported and figured in an article published in 1913[1]

The material, a mass of peat several feet long, was exposed twice during the summer, after severe storms. It was embedded in the sand and appeared to continue landward as it disappeared under the sloping beach A piece approximately a foot and a half in diameter was broken from the mass and is now in the *Museum of the Department of Botany*, Wellesley College Other deposits, one described by a fisherman as "turf with stumps in it," were reported to have been exposed during winter storms

The occurrence of peat in this situation was interpreted at that time as the remains of a marsh flora, developed from a lagoon formed by an old fringing bar As the bar was pushed inland the sand overwhelmed the marsh and continued retreat of the shore line again exposed the buried vegetation.

LAETITIA M. SNOW

WELLESLEY COLLEGE

SPECIAL CORRESPONDENCE

A FLORA OF MEXICO

OUR knowledge of the flora of Mexico is scattered through a multitude of systematic papers and a relatively small number of local floras, with only very few general works The fundamental work for the study of the flora as a whole, Hemsley's four volumes of "Botany" (1879–88) in Salvin and Godman's great "Biologia Centrali-Americana," enumerates 12,233 species of vascular plants growing in the region from Mexico to Panama, with the citation of synonyms and specimens examined (the latter almost confined to the material in the Kew Herbarium) There are no keys, no vernacular names and no account of uses, and the botanist who does not have access to a large botanical library can derive little profit from it Paul C Standley's "Trees and Shrubs of Mexico" (1920–26) covers the woody plants very satisfactorily, giving keys, brief descriptions, synonymy and range, but its greatest value, perhaps, lies in the condensed accounts of uses and lists of vernacular names which the author has brought together under each species The approximately 5,700 species included in this work represents perhaps half the known flora. The floras of several of the islands on the west coast have been published by Sereno Watson, E L Greene, J N Rose (partly in collaboration with George Vasey), Alice Eastwood and Mrs. R S Ferris. L A. M Riley's "Contribution to the flora of Sinaloa" (1923–24) was left incomplete at the death of the author and covers only the Polypetalae A flora of the same state, the descriptive part of which, containing various new species, is unfortunately printed on unnumbered pages so as to be almost impossible to cite, is in process of publication by J G. Ortega in the "Boletín de Procultura Regional" of the Sociedad Cooperativa Limitada of Mazatlán Millspaugh's "Plantae Yucatanae," mostly written in collaboration with Mrs Agnes Chase, was suspended nearly thirty years ago, after only five families had been covered. This gap has been filled by Standley's "Flora of Yucatan" (1930), the only complete flora of any Mexican state. The very interesting flora of the peninsula of Lower California, an area not included in Hemsley's "Botany," has been pretty thoroughly covered by T. S Brandegee, especially as to the "Cape Region," and additional lists of value have been published by E. A. Goldman and I. M Johnston.

The participation of United States botanists in the investigation of the flora below the present northern boundary of Mexico practically began with Asa Gray's papers on Charles Wright's second Texan and New Mexican collection (1853) and on Thurber's New Mexican and Sonoran collections (1854), and Torrey's "Botany of the [Mexican] Boundary" (1859), in which Gray collaborated. Into these works occasional species collected within the present limits of Mexico were introduced. Gray's papers on Xantus' plants from Lower California and L. C. Ervendberg's from Wartenberg, near Tantoyuca (both in 1861), were the first papers devoted entirely to Mexican plants published in this country. After a gap of fifteen years, Sereno Watson's two papers (1876) on the flora of Guadalupe Island, based on Palmer's 1875 collection, began the long series of publications from the Gray Herbarium devoted to the results of the Mexican explorations of Palmer, Pringle and other collectors The paper by George Vasey and J N Rose (1889) on Palmer's plants of 1889 from Lower California initiated the activity of the U S National Herbarium in the description of the Mexican flora, in the investigation of which Dr Edward Palmer, who collected for the United States Department of Agriculture, played a part equalled only by Pringle

---

[1] Laetitia M Snow, "Progressive and retrogressive changes in the plant associations of the Delaware coast," *Bot. Gaz.*, 55 (1). 45–55, fig 6, 1913.

It will be noticed that with the exception of two floras, both of which are incomplete, all the publications above mentioned on the geographical botany of Mexico since the time of Hemsley have been produced by botanists of the United States An explanation of this, of course, is to be found in the relative accessibility of Mexico as a collecting field to the botanists of its northern neighbor Of the trinity of modern botanical collectors in Mexico whose specimens have been widely distributed—Palmer, Pringle and Purpus—the two first were citizens of the United States and the third collected principally for T S Brandegee The very extensive Mexican collections of J N Rose are, of course, found principally in the U S National Herbarium The largest collection ever made in a relatively small area in Mexico, that of Brother G Arsène and his associates from the regions of Michoacán and Puebla, is most completely represented in the same herbarium

The case is quite otherwise as regards our knowledge of the useful and medicinal plants of Mexico and their vernacular names These matters appear to have received no attention from Pringle, but were among the primary objects of Palmer's work in Mexico on behalf of the Department of Agriculture Opportunities for acquiring information on such subjects, however, are of course much greater to residents of a country than to those who visit it only on relatively brief collecting trips We find, consequently, that most of the important contributions have been made by botanists resident in Mexico The principal works on medicinal plants are L Flores' "Manual terapéutico de plantas mexicanas" (1909), B. Cuevas' "Plantas medicinales de Yucatán . " (1913), and L Suc's "Les plantes medicinales du Mexique" (1912), the last a compilation from the University of Toulouse For useful plants in general, the outstanding works are J. N. Rose's "Notes on useful plants of Mexico" (1899), which was based principally on the author's own observations and those of Palmer, and M Martínez' "Las plantas mas utiles que existen en la república mexicana" (1928). For vernacular names, the principal sources are J. Ramírez and G V Alcocer's "Sinonimia vulgar y científica de las plantas mexicanas" (1902), and M Martínez' "Catálogo alfabético de nombres vulgares y científicos de plantas que existen en Mexico" (1923–) The latter, not yet completed, is similar in plan to Ramírez and Alcocer's "Sinonimia," but contains many additional names. Nicolas Leon's "Bibliotoca botánico-mexicana" (1895), a work of 372 pages, contains an alphabetical list, with publications, of 805 authors who have written on the flora of Mexico, with sketches of botanical explorations and collectors José Ramírez' "La vegetación de Mexico " (1899) discusses the phytogeographical divisions of Mexico proposed by various authors, and in addition contains a useful hundred-page list of altitudes of localities The only attempt at a list of Mexican plants since Hemsley, M Urbina's "Catálogo de plantas mexicanas (fanerógamos)" (1897), based on the collections of the Museo Nacional, contains only about 3,000 species, and represents less than a third of the known flora

The task of bringing into one work the information scattered through so many publications is a gigantic one It has been undertaken by Professor Cassiano Conzatti, of Oaxaca de Juarez, known to botanists of the United States for many years as the collector of excellent specimens of Mexican plants More than thirty years ago Professor Conzatti, in collaboration with L C Smith, a clergyman in Oaxaca, published Parts 2 and 3 of a "Flora sinóptica mexicana" (1895–7) A second edition of Part 3 was published in 1910, but Part 1 has never been published The parts published included 2,505 species, representing only the Corolliflorae Professor Conzatti is now actively engaged in the preparation of another work, with the same title, intended to summarize our present knowledge of the vascular plants of Mexico It will include descriptions, abridged but sufficiently full for purposes of identification, of all the families, genera and species, with their principal synonyms, their ranges and an account of their important economic uses The treatment of the first 60 families, from ferns to Iridaceae, has already been written From the nature of the case, the work will be largely a compilation, and the author wishes to obtain the consent of United States botanists to the use in free translation of their published works on the Mexican flora for his book One of his primary aims is to stimulate the spirit of observation and study among the youth of Mexico by making available to them in their own language a synoptical account of the plants of their native country In this undertaking he deserves and will undoubtedly receive the support of the botanists of the United States.

S. F Blake

Bureau of Plant Industry,
Washington, D C

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW MICROMANIPULATOR

IN some recent work with amebae it was necessary to isolate individual cysts and vegetative forms Complex devices such as the Chambers or Taylor micromanipulators were impracticable for this purpose The above apparatus is relatively simple, and has the important advantage of picking up objects from the upper surface of the slide

Dr H C Hinshaw, formerly of this department, had this manipulator built It is attached to the binocular body of a Leitz microscope (Fig 1), and therefore, since it moves up and down with the adjustment of the microscope, the pipette is always in focus It is used with the 16 mm or as high as the No 5 Leitz objective The manipulator itself is made of aluminum with German-silver springs and screw thrusts Two vertical screw thrusts (A and B) push against steel balls working in a groove They give movement in the vertical and one horizontal plane The horizontal screw thrust (C) pushes against a steel spring (D) and gives movement in the third plane

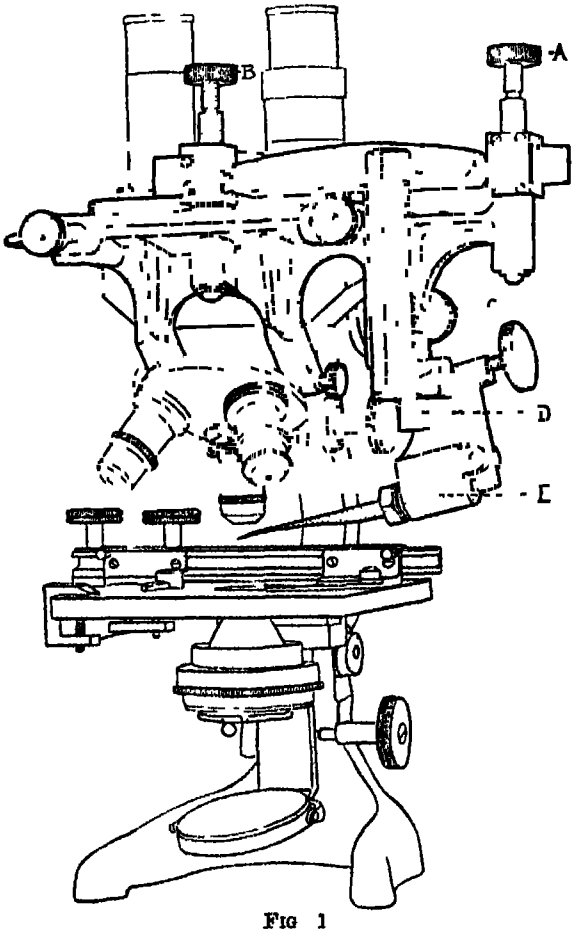


FIG 1

Dr Hinshaw left before perfecting the instrument or working out a satisfactory method of pipette control After many trials of various devices a new pipette holder was built (E and Fig 2) It is essentially a modification of the Taylor holder, except that it is smaller and makes use of the principle of the lever (F) and removes the screw from the direct line of the pipette In this way much more delicate control is obtained, and movements from the operator's hand are not transmitted to any great extent. It consists of a brass cylinder into which fits a piece of glass tubing (G) filled with mercury and capped with a piece of rubber Into the smaller end of this mercury column is cemented the micropipette (H) A metal plunger (I) controlled by the thumb screw (J) pushes against the rubber and so controls the column of mercury, in this way pulling in or expelling an object from the micropipette

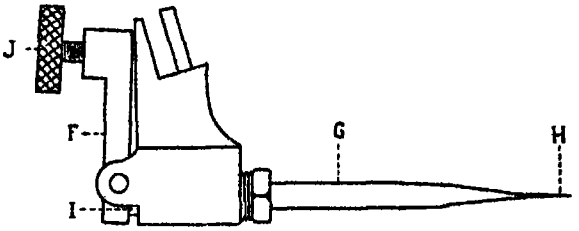


FIG 2

The manipulator combined with the mechanical stage gives a unit which has controlled movements in three planes Stage movements and the coarse adjustments of the microscope give the coarse adjustments of the unit The screw thrusts of the manipulator plus the fine adjustments of the microscope control the finer movements.

In the handling of cysts of amebae the instrument is used in the following way. A drop of material containing amebae is put in the lower left-hand corner of the slide To the right of it are placed two or three drops of Locke's solution. To the right of them is a cover slip with a drop of reagent on its surface. A cyst is picked up by the pipette, the mechanical stage is moved along until the first drop of Locke's is in focus, the cyst is washed, picked up, the stage is moved again, etc., until the cyst is finally in the drop of reagent on the coverslip.

ETHEL MCNEIL
J. E. GULLBERG

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CALIFORNIA,
BERKELEY,
JULY 1, 1931

A SINGING TUBE

DR. ROBESON has recently reported the construction of simple forms of singing tubes.[1] I had the following experience in the spring of 1919, while an undergraduate at Middlebury. Pieces of soft glass tubing of about 10 cm length and 6 to 7 mm diameter were being formed into combustion tubes by sealing and slightly expanding one end. Chancing to blow a bulb of about 20 cm diameter on one of the tubes, I was startled by the immediate production of a singing note of considerable intensity which continued for well over a minute. Moderate heating of the bulb in a Bunsen flame was enough to repeat the phenomenon, but with a lesser intensity because of care exercised to avoid softening of the glass. The tube lay on my desk for several weeks and could be made to sing merely by heating in the flame of a match until its usefulness was ended by accidental dropping. I made several attempts to reproduce it but with no success.

My tube differed from those of Dr. Robeson in these respects: the bore was larger, heating of the bulb rather than of the junction of bulb with tube started the singing, the starting temperature was low, and to the best of my recollection there was no noticeable variation of pitch with change of temperature.

WILLIAM R. COLE

LINCOLN UNIVERSITY

PURE SMOOTH AND ROUGH COLONY TYPES AT WILL

ANIMAL bacteriologists since 1890 and plant bacteriologists in more recent years have been much interested in the study of two colony types, smooth and rough, produced by many bacterial organisms.

The usual procedure for obtaining the separate colony types for study has been to pick a smooth or rough colony from a poured agar plate produced by the usual bacteriological technique, *i. e.*, a needle transfer of the culture (broth, agar slant or diseased material) to a tube of liquid (broth or water) and sometimes from the first tube to a second tube. A transfer is then made from each dilution tube to melted agar for poured plate examination. When beef infusion broth or agar is used it is usually adjusted to pH 7.0 or neutrality.

From this form of technique the plates may or may not be pure cultures of S or R colonies.

The production, at will, of pure plate cultures of the S and R colony forms of three bacterial organisms has been made possible by a modification of the usual bacteriological technique and it is believed that the purity of types and an abundance of material can be assured for the further study of the two forms.

MODIFIED TECHNIQUE

Make a needle transfer of the culture (broth, agar slant or diseased material) to a pH 6.0 and a pH 7.0 beef infusion broth tube. Then make a second dilution tube from each pH grade of the (1) seeded broth tube. Hold the (2) dilution broth tubes in both pH grades for 18 or 24 hours at room temperature.

After this growth period again make (1) and (2) dilutions from each pH grade of the young culture to a corresponding pH grade of broth. From the last (2) dilution broth tube transfer to a melted pH 6.0 and pH 7.0 beef infusion agar tube for poured plate examination.

This modified technique produces on the plates pure culture of the S or R colonies.

This technique involves three factors necessary to assure the pure S and R colonies. They are as follows:

(a) dilution before and after the young growth period of the organism.

(b) young culture.

(c) pH of the culture medium.

For the smooth colony use only pH 7.0 medium. For the rough colony use only pH 6.0 medium.

The S colony is virulent, the R colony is avirulent.

Attention is called to the fact that an interchange of pH grade from broth to agar plate may result in intermediate types with a corresponding interference in demonstration of virulence and nonvirulence on the host plant.

Reversion of the R type back to the S type will be discussed in the complete manuscript soon to be published.

Virulence was demonstrated by inoculation on the host plants with the pure S colonies and nonvirulence by inoculation with the pure R colonies of *Bacterium tumefaciens*, hop strain, and *Bacillus phytophthorus* organisms.

Later tests with single cell isolations from the S and R types produced in the first *B. phytophthorus* culture study corroborated the evidence produced in the earlier study in every particular.

The single cell progenies were kindly furnished by Dr. A. J. Riker.

The third organism studied was a corn borer parasite as yet unnamed and unpublished.

AGNES J. QUIRK

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF
AGRICULTURE

---

[1] SCIENCE, March 6, 1931, p. 265.

SPECIAL ARTICLES

HETEROTHALLISM IN PUCCINIA TRITICINA[1]

CRAIGE[1] [2] discovered in 1927 that the spermatia (pycniospores) of the rust fungi are active functional spores which serve in some way to initiate the sporophyte generation of the rust. Since then other workers have proved by greenhouse investigations that these spores can be used in producing hybrids between physiologic forms of a rust, and a beginning has been made by cytological methods in learning how these spores function. C. F. Andrus, in a paper presented before the Botanical Society of America in December, 1930, reports the occurrence in the gametophyte generation of *Uromyces appendiculatus* (Pers.) Fries of trichogynous hyphae which "are much branched and highly septate organs having their terminus at the epidermis of the host leaf where they project through stomata or between epidermal cells and make contact with spermatia." Nuclei of spermatia enter these trichogynous hyphae and initiate the sporophyte generation.

Puccinia triticina Eriks., the leaf rust of wheat, has its aecial generation upon species of Thalictrum. The sporidium, formed by the germinating teliospore, in the spring, is a haploid spore, and when it falls upon a Thalictrum leaf it germinates, enters directly through the outer epidermal wall, and forms a 4- to 6-cell hypha in the epidermal cell, which in turn gives rise to haploid, intercellular mycelium.

After 6 or 7 days of vegetative growth reproductive activities set in. Spermogonia (pycnia) form at both surfaces of the leaf. A count of a hundred spermogonia in 11-day infections shows that 46 open upon the upper surface and 54 upon the lower.

At the same time that spermogonia are forming, hyphae near the lower surface of the leaf grow into stomatal apertures. A hypha in a stoma is short-lived, but successive hyphae present themselves at the same stoma. It is not uncommon to find 5 or 6 hyphae in the same stomatal aperture, only the last of which is living. In addition to this an occasional hypha at the upper epidermis forces a passageway between epidermal cells to the upper leaf surface. In older leaves this development at the upper epidermis is limited. In infections on young tender leaves it is more abundant. There may even be an extensive subepidermal growth of mycelium giving rise to groups of upright hyphae that push up to the surface. Hyphae reaching the lower or upper leaf surface through stomata or between epidermal cells are regarded as receptive hyphae.

In the substomatal air space, beneath a stoma occupied by one or more receptive hyphae, the hyphae grow and branch rapidly, forming a dense little nest of cells—the beginning of an aecium. If, as not infrequently happens, practically all the stomata in an infected area are occupied, there is not room for so many aecial primordia, and only a part of them develop. Over a large vein, where stomata do not occur, aecial primordia are absent.

Puccinia triticina is heterothallic. A monosporidial infection may bear both spermogonia and receptive hyphae, but, if kept isolated, it will remain sterile. Unless spermatia are brought to it from another and different infection, the aecia remain haploid and after the first differentiation into an upper area of small dense cells and a lower area of large empty cells, the whole aecium gradually degenerates and dies. With rare exceptions the sterile aecium consists of uninucleate cells from beginning to end.

A comparative study of a number of young infections of the same age shows that some have many spermogonia and few receptive hyphae, others have comparatively few spermogonia and more receptive hyphae, and a few have no spermogonia whatever and abundant receptive hyphae. The intermediates in this series are more numerous than the extremes, although some, at first classed as intermediates, have since been proved to be of multisporidial origin.

This is not just a temporary condition of young infections. In one sterile infection 42 days old there were 103 spermogonia and only 23 small sterile aecia. In another large sterile infection from the same lot of material there were over 200 sterile aecia and no spermogonia whatever. Moreover, in this latter, the average size of the aecium was much greater than in the spermogonial infection. The infections of *Puccinia triticina* can be arranged into a series with an almost exclusively spermogonial type at one end and a completely aecial type at the other.

Before fertilization, the receptive hyphae, like the haploid mycelium producing them, consist of uninucleate cells. When fertilization takes place, the receptive hyphae at the stomata are found crowded with nuclei. Two to 6 nuclei are common and as many as 11 nuclei in a cell have been seen. Growth from these cells permeates the aecium. The young fertile aecium grows vigorously and is composed of a matrix of haploid cells interspersed throughout with cells containing 2 or more nuclei The aecium becomes differentiated into a lower half of large vacuolated cells, which later die, and an upper half of smaller denser cells In this upper area multinucleate cells are abundant The number of nuclei varies, ranging in extreme cases to 15 or 20 per cell With further growth and cell division the number of nuclei per cell decreases From this mass cells grow down to form the sporogenous layer of "basal" cells Young basal cells contain from 2 to 8 nuclei The extra nuclei are used in forming the first spores and by the time the spore chains are well started the basal cells are regularly binucleate

---

[1] J. H. Craigie, "Experiments on Sex in Rust Fungi," *Nature*, 120: 116–117, 1927.

[2] J. H. Craigie, "Discovery of the Function of the Pycnia of the Rust Fungi," *Nature*, 120: 765–767, 1927.

The question of the effectiveness of the receptive hyphae that grow to the upper surface of the leaf is still an open one Aecia occur that open on the upper surface, but they are uncommon Either fertilization of the upper receptive hyphae is rare, or those that are fertilized grow to the lower surface before developing further So far this has not been observed

Ruth F Allen
Bureau of Plant Industry,
U S Department of Agriculture, and
California Agricultural Experiment
Station

THE REDIA OF THE GASTEROSTOMES[1]

An intermediate generation has been found in the life history cycle of the trematode order *Gasterostomata*, thereby bringing this form into line with normal life histories of other digenetic trematodes The adult of this generation, the redia, is found in abundance in the lumen of the young mother-sporocysts Young redia dissected from the mother-sporocysts are very active swimmers due to the covering of long cilia over the entire surface of the body Older specimens indicate a loss of cilia followed by a coating of spines which are similar in character to the final adult Two eyes are present The redia is hermaphroditic The testis is large, median in position with an extensible penis In a live redia, mature active spermatozoa have been observed The ovary is small, below the testis on the left side Laurer's canal is long and apparently functions in cross-fertilization as a sperm-duct leading to the ovary The vitelline complex in two lateral rows is very well developed Eggs are shed through a short oviduct into the cavity of the mother-sporocyst and give rise to cercariae

The origin of the redia was found to be in the gonads of the mother-sporocyst, and localized in the distal ends of the branches. The testis is large and situated below the tip of the branch previous to the expanded portion of the lumen. The ovary in the mother-sporocyst of ***Bucephalus pusillum*** appears in the form of "stroma." In ***B elegans*** the ovary is located in a "plug" extending downwards into the lumen. This "plug" is composed of the ovary and nutritive glands, both in the form of "stroma" which, as development proceeds, extend for a considerable distance through the lumen even in older branches heavily packed with cercariae

Spermatogenesis has been worked out in detail for all three generations, in the mother-sporocyst, redia and final adult

It is therefore concluded that each of the three generations starts with a fertilized egg and gives rise to hermaphroditic "adults" Maturation with polar bodies and reduction is evident There is no parthenogenesis or metagenesis The life history of the trematodes as witnessed in this order is simple, with comparable embryological and larval stages in each of the three generations The differences in the adults undoubtedly has evolutionary significance and is probably due to parasitism first, within a mollusk, second, within the mother-sporocyst, and third, within the vertebrate

Other species, not related to the gasterostomes are being studied by the author to find out how universal this method of reproduction is, among the class *Trematoda* Material to be examined must be young before the reproductive stage is over and before the nutritive phase increases to confuse observation Completely known life cycle material is preferable Differential staining is advisable

Arthur E Woodhead
University of Michigan

VARIATIONS IN THE EVENING PRIMROSE INDUCED BY RADIUM

Geneticists are now aware that x-rays and radium are agents by which genetic changes, both genic and chromosomal, may be produced However, in the several years since 1927, in which many investigators have published on the genetic effects of irradiation on both plants and animals, nothing, in so far as I am aware, has appeared dealing with the irradiation of the evening primrose For the past three years the writer has been making such an investigation, using radon (radium emanation) in the treatment of *Oenothera Lamarckiana* and *Oe franciscana*, a preliminary account of which appears here

The method of treatment was to insert an unfiltered tube of radon parallel with the buds in a flowering cluster, thus treating buds in all stages of development at distances varying from direct contact to 4 cm. As the flowers opened after treatment they were self-pollinated Eight irradiations of *Lamarckiana* and four of *franciscana* were made, the tubes of radon used varying from 7 millicuries to 17 mc, and the times of application from four to twenty hours. At the same time, flowers on another shoot of the same plant were selfed (being adequately protected by lead) to provide control material In all cases, control families have shown only the usual species characteristics

---

[1] Contribution from the Zoölogical Laboratory of the University of Michigan.

The immediate effects of the radium treatment were a development after two days or less of a necrotic area in the cluster where the radon tube had rested, an abscission of buds thus affected regardless of size or age unless the injury was very slight, and a necrosis of all buds in the stages of meiosis or younger The rate of flowering, the size of the flowers, and the fertility, chiefly of the pollen, were affected to a greater or less degree depending on the dosage

Single capsule sowings were made in 1930 of the seed from treated buds, making 95 families of *Lamarckiana* origin and 29 families of *franciscana* origin The percentage germination was lowered in those cultures which had the heavier dosages As the seedlings developed their rosette characters it was found that many unclassifiable leaf shapes, sizes and peculiarities existed in both *Lamarckiana* and *franciscana* In the majority of cases, the leaves were very much distorted and retarded in growth In some cases, however, quite new and distinct leaf features were present In *Lamarckiana* material small, weak plants were rather common in irradiated cultures, some with very unusual leaf characters, mottled, pale green, reduced size, wiry, irregular, no crinkling, excessive crinkling and the like No two were identical. In the *franciscana* cultures the same general conditions were present, although the percentage of abnormal forms was lower However, the most striking of the radium variants have been in *franciscana* material

It is unfortunate that the vast majority of the atypical forms mentioned above were too weak to survive field conditions, either dying or not coming into bloom. A few of the stronger ones did bloom, however, and have proved very interesting plants The abnormal characteristics manifest in the rosette condition continued and new ones peculiar to the mature condition appeared As a rule, the flowering tip was smaller, bore fewer flowers, and had quite a high percentage of buds drop before blooming The flowers were generally smaller, distorted in most features, and pollen sterility was much in evidence Some few plants were wholly sterile.

Breeding work, in so far as was possible, was done with the above forms The progenies are now being grown It is known definitely that one of the abnormal types found in *Lamarckiana* when selfed throws a progeny in which the parent type composes approximately one-fourth (7 in 27) of the population. This type is a little more viable than the majority. It is a form with dull coarse leaves, free from crinkling with very irregular margins, sometimes toothed. The behavior at present suggests some unbalanced chromosome condition

One of the more viable of the atypical *franciscana* forms was selfed and its progeny grown this summer. An entirely new form has appeared, extremely weak with very linear mottled leaves. Twenty-three of these plants have appeared in a population of 64, the frequency suggesting a 1 2 ratio It is disappointing that this new form is not viable under field conditions. Selfings are being made among the 41 other plants in the hope of discovering a few heterozygotes which will give the same form next year.

Many of the normal plants in irradiated cultures were selfed in the summer of 1930, so that any recessive condition induced by radium treatment might appear in their progeny this summer. In one case, that of a *franciscana* plant, an abnormal type has appeared In a population of 25 plants, four are of this new type, characterized chiefly by the tiny, much distorted crinkled condition of the leaves on the flowering tip

It is intended to continue the genetical investigation on these new forms occurring in the progenies from radium-treated buds, in so far as the conditions of reduced fertility will permit. It is also planned to investigate the chromosomal conditions in the radium variants

I wish to acknowledge the invaluable aid of those who are making this work possible Dr Halsey J. Bagg, of Memorial Hospital, New York City, who has kindly supplied me with the radon, and Dr George H. Shull, of Princeton University, who has been very helpful in his guidance and criticism.

WM. H. BRITTINGHAM
PRINCETON UNIVERSITY

BOOKS RECEIVED

BINET-SANGLE, DOCTEUR. *Les Ancêtres de l'Homme.* Pp xx + 290 16 photographs Michel Paris 25 francs

CAMPBELL, GEORGE A and RONALD M FOSTER. *Fourier Integrals for Practical Applications.* Pp 177. 7 figures Bell Telephone Laboratories

DITMARS, RAYMOND L *Snakes of the World.* Pp xi + 207. 84 plates Macmillan $6.00

HALE, GEORGE E *Signals from the Stars* Pp xx + 138 Illustrated Scribner's Sons. $2.00.

MAXWELL, JAMES CLERK *A Commemoration Volume. 1831–1931.* Pp viii + 146 2 portraits. Macmillan. $2.50

NEW YORK COMMISSION ON VENTILATION. *School Ventilation · Principles and Practices.* Pp. ix + 73. Teachers College, Columbia University $1.00.

ROBINSON, HOWARD *Bayle the Sceptic.* Pp. x + 334. Illustrated. Columbia University Press. $4.25.

SCIENCE

Vol. 74 | Friday, November 13, 1931 | No 1924

The United States Army Medical Department and its Relation to Public Health Major Edgar Erskine Hume ... 465

Obituary
Richard Alexander Fullerton Penrose, Jr. Dr. Joseph Stanley Brown *Recent Deaths* ... 476

Scientific Events
The Bermuda Fresh-water System, Topographical Maps, The Agricultural Experiment Stations, A New Harvard Observatory, A Junior Nobel Award ... 478

Scientific Notes and News ... 481

Discussion:
Concerning an Increase in the Potency of Mosaic Virus in Vitro Dr. Peter K Olitsky and Dr. Filip C Forsbeck *Geomorphological Evidence of a Climatic Boundary*: Professor Richard Joel Russell. *Chlorates as Herbicides* Dr. W E Loomis, Russell Bissey and E V Smith *The Causative Organism of a Papular Type of Apple Measles* Professor Anthony Berg. *Biological Abstracts* Dr. Paul D Lamson ... 483

Scientific Apparatus and Laboratory Methods
An Adaptation of the Box Camera to Photomicrography Dr. Charles S Apgar. *A Method for the Preservation of Old Manuscripts* J P. Sanders and Dr. F K Cameron *The Use of Live Nemas (Metoncholaimus Pristiurus) in Zoological Courses in Schools and Colleges* Dr. N A. Cobb ... 487

Special Articles:
A Chart of Radioactive Elements Indicating their Structure. Professor Ingo W D Hackh. *The Sugar Tolerance of Yeasts Expressed in Atmospheres*. Dr. Margaret B Church *More Data on the Lung Fluke in North America* Donald J Ameel ... 490

Science News ... 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City. Grand Central Terminal

Lancaster, Pa | Garrison, N. Y.
Annual Subscription, $6 00 | Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C

THE UNITED STATES ARMY MEDICAL DEPARTMENT AND ITS RELATION TO PUBLIC HEALTH[1]

By Major EDGAR ERSKINE HUME

MEDICAL CORPS, U S ARMY

An army exists for the purpose of destroying the power of the enemy and preventing his retaliating in kind. The medical department of an army is, as are all branches, charged with doing all possible to bring about this end. Specifically, in the words of our army regulations:

> The mission of the Medical Department is the conservation of man power—the preservation of the strength of the military forces. This is accomplished by the selection and enrolment for military service, through properly conducted physical examinations, of only those men physically fit for the performance of the duties to devolve upon them, by keeping such personnel in good physical condition through the application of modern principles of preventive medicine, and in furnishing those who do become disabled with such aid in the form of evacuation and hospitalization facilities as will speedily restore them to health and fighting efficiency.

This is a clear statement of our duty in general terms, and the manner of its performance in modern warfare may be appreciated when I tell you that, in the world war, 85 per cent of the total number of American army battle casualties were returned to duty, and a total of 95 per cent. of the sick and ordinary injuries were returned to duty And to those who do not know of the work of the medical service in combat, let me say in passing that though ordinarily considered "non-combatants," the casualties in our department at the front in the great war were second only to those of the Infantry Just consider that there were, in proportion, more men killed or wounded among the officers and enlisted men of the Medical Department than among those of the Artillery, Air Service, Cavalry, Signal Corps or Engineers who saw front-line service

---

[1] The fourth annual Delta Omega lecture at the Massachusetts Institute of Technology, April 8, 1931. The Delta Omega lecture is delivered each year before the chapters of the Delta Omega Society of the Massachusetts Institute of Technology and of the Harvard School of Public Health, and to it the public is invited The Delta Omega Society, to which selected students of public health are admitted, was founded in 1924 at the School of Hygiene and Public Health of the Johns Hopkins University Other chapters have been established at Harvard, the Massachusetts Institute of Technology, Yale, Michigan and California.

I do not propose discussing to-day the work of our corps in its purely military duty. That would be of only secondary interest to you as public health men Though there can be no really essential difference in the work of the military sanitarian and his civilian confrère, there are certain aspects and limitations of the work of each which I propose to mention The fear of "state medicine," that bugbear of the general practitioner, has at times led to ill-founded statements and distortion of facts regarding the federal services

Military sanitation is the prevention of disease in armies More specifically it consists in the practical application, under diverse conditions met in the field and camp or permanent garrison, of a system of principles relating to the preservation of health It embraces all the details which relate to public health, in a civil community, and in addition must take cognizance of other factors which either do not enter into or can not be controlled in civil life

While the civilian health officer has to deal with the population as he finds it, the military sanitarian can choose the bulk of his human material in the form of recruits, the proper selection of the soldier constituting one of the most important requirements for attaining satisfactory health conditions and the greatest degree of military effectiveness The fundamental reason for military sanitation is not humanitarian, but increased military efficiency and the application of sanitary principles adapted to the requirements of the military machine assist in the struggle for victory

I do not mean to imply that civilian health officers should not be interested in military sanitation Quite the contrary Wars are now waged not by armies alone, but by the entire resources of personnel and matériel of nations This can not well be otherwise in view of the possibilities of the wars of to-day and to-morrow, and we must face these facts, whether we like them or not In the broad sense were we to be drawn into a war now, each one of us, including you, would, in a measure, be called upon to practice military sanitation and military preventive medicine, and this holds true whether we have a large army, a small army or no army at all

In time of peace, a military command living at an army post is composed of individuals, not excepting civilians of all ages, under a much more complete control than is possible outside the service Obviously the military health officer's work is rendered more simple thereby He has but one man to convince of the desirability of the step that he recommends, and that man is the commanding officer The commanding officer is responsible, and, having been convinced, can issue a military order which will be binding upon each and every soul, living upon the post. Civilians not wishing to comply with such orders are not permitted to remain Of course such a condition requires complete confidence in the health officer, or medical inspector as he is called in the service, on the part of the commanding officer A commander who does not trust the ability and knowledge of his medical advisers usually is not slow in taking steps to secure their replacement On the other hand, the military officer of health has special difficulties His great power is at once a source of weakness He is immediately blamed for anything that goes wrong in a medical way, and usually he has to carry the responsibility alone Military personnel are by the very nature of things unable to live in the same way as civilians There are medical conditions incident to overcrowding, exposure and long hours, problems concerned with the supply of potable and sufficient water in the field, the disposal of body and other wastes when on the march and in camp, venereal infections, and many others, all of which must be considered in a different light from that in which the civilian health officer labors The recommendations made must be adapted to the necessities in each case

The greatest of all differences in the recommendations of the military as contrasted with the civil health officer is that of objective The civil health officer knows no higher law than the preservation of human life and health Other considerations are secondary But in the army the military necessity must come first. This is, of course, considerably less so in time of peace than in war, but the difference is always felt The medical inspector in the army may know that to order soldiers into a certain locality will inevitably result in increased incidence of disease or even loss of life, yet such orders may be necessary and therefore, to a soldier, desirable A medical officer who merely recommends against such action, relying on the fact that it is not himself but the commander who must bear the responsibility, or who otherwise offers only destructive criticism, is not worthy of his salt He is, under such circumstances, merely an *objector*, a "no-man," far more deadly than the "yes-man," to use a bit of army slang So the military officer of health must possess a sufficiently broad knowledge of his subject to be able to offer sound advice in such times of stress or in handicap conditions. A mere recollection of rules of thumb will not suffice him

With modern advances in preventive medicine and the consequent increasing degree of protection from communicable diseases afforded the children and youth of the nation, special problems arise for the military health officer. More and more of such children attain adult years without having acquired immunity to certain diseases by having had them, or with low resistance to some of the common communicable diseases This has an important bearing on mobilizations of troops that may be necessary in the future, as well as in the peace-time problems of army life Recruits are having a higher and higher group susceptibility not only to those diseases of which one attack confers permanent immunity, but also to those, resistance to which is developed by repeated exposure or attacks

Entirely aside from all this, military medical officers in their turn must at all times be interested in every means of preserving the health of our whole population and of preventing diseases in general This phase of our task will be of more interest to you than the other

"When," as Surgeon-General Ireland says, "the profession of public health has made an advance, the army has advanced with it, and occasionally it has led the profession" Our corps is a small body consisting of less than a thousand medical officers, and as this group has the task of providing medical and surgical attention of every sort to the army and its dependents, at home and abroad, there can be but a comparative few whose duties are spent chiefly in the field of public health and hygiene

Let me run over some of the work that our officers have done in this field in the past In other words, let me recall to you some of the contributions to sanitary science of members of the medical department of your army I limit myself to career medical officers or those whose work has been performed while they were in the service Otherwise I should merely be reviewing the work of American medical science in general, for in time of war practically the entire medical and public health professions have been and will again be at the service of the government

Our army medical department has numbered on its rolls not a few of America's foremost men of science As early as the Revolution, Washington's army included such men as John Morgan and William Shippen, both graduates of Edinburgh and successively directors general of the army They were leading pioneers in medical education and the principal founders of the medical department of the University of Pennsylvania, the oldest medical school in this country (1765). Associated with them in the Continental Army was an even more distinguished officer, Benjamin Rush, likewise an Edinburgh graduate and sometime physician general of the Middle Department He succeeded Morgan as professor of practice in the College of Philadelphia, and was the founder of the Philadelphia Dispensary, the first in America (1786). He was the ablest clinician of his time, a signer of the Declaration of Independence, and dubbed by Lettsom the American Sydenham. His monograph on insanity was the only systematic treatise before 1883, and of particular interest to us as public health men is his well-known account of the Philadelphia epidemic of yellow fever to which I shall refer later He also wrote a valuable pamphlet on the hygiene of troops (1777), and his papers on the American Indian are considered the first American contributions to anthropology

The earliest American pharmacopoeia was that prepared for the use of the Continental Army by William Brown, of Virginia, who succeeded Rush as physician general of the Middle Department It appeared in Latin in 1778 The first surgical work published in this country was from the pen of John Jones, a soldier of the French and Indian, and Revolutionary Wars, and as it included an appendix on camp and military hospitals, it must be reckoned the first American book on military medicine

James Tilton, one of the early surgeons general after the Revolution, introduced the "hut system" during the war to avoid overcrowding of hospitals, a step much in advance of the then prevailing usage in this and other countries

In 1834, Joseph Lovell, the first surgeon general of the army under the reorganization of 1818, introduced competitive examinations for admission to the Medical Corps, one of the two administrative measures for which he is remembered, the other being the abolition of the whiskey ration—a valuable step, though hardly popular with the general public of those pre-Volsteadian days

The surgeon general of the army just after the outbreak of the war of 1861 was William Alexander Hammond, who made his mark as a physiologist by his essay on "The Nutritive Value and Physiological Effects of Albumin, Starch and Gum when Singly and Exclusively used as Foods," which won him a European reputation, the medal of the American Medical Association (1853) and the chair of anatomy and physiology at the University of Maryland, in 1860. He continued Tilton's provisions for the prevention of overcrowding by the extensive construction of hospitals upon the pavilion system And he did more. In the words of another great military medical officer, Weir Mitchell, "he duly saw and grasped a great opportunity, and served his country as few could have done"; he created the Army Medical Museum, now the largest institution of its kind in the world His systematization of medico-military reports led to the compilation, under his administrative successors, of the extensive "Medical and Surgical History of the War of the Rebellion" (a title that possibly would not have been chosen to-day), "with the publication of which," said Virchow, "began a new era of military medicine." It was the prototype of the even larger "History of the Medical Department of the U. S. Army in the World War." Another of Hammond's contributions was his cutting of calomel and tartar emetic from the supply table of the army. This may seem a small matter to-day, but not if we recall the once orthodox practice of producing and ascribing wonderful curative properties to mercurial salivation and mild antimonial poisoning. Nor must we suppose that the medical profession received Hammond's action calmly, for a great cry was raised. Under this chief the army planned and adopted the use of ambulances, thereby setting an example for civilian hospitals to follow later.

During the war of 1861 Assistant Surgeon Da Costa first described the irritable heart in soldiers (1862) and Assistant Surgeons S. Weir Mitchell, George R. Morehouse and William W. Keen made their investigations of gunshot and other injuries of nerves (1864) which have become classical. All these men are known to the world as the foremost American physicians and surgeons.

The war of 1861 produced another outstanding medical officer, John Shaw Billings, the father of the Army Medical Library, to be discussed later. Billings was the author of the best history of surgery that has been published in English, the designer of the Johns Hopkins and other modern hospitals and of the New York Public Library—certainly a wonderful contributor to scientific advance. His survey in 1870 of the Marine Hospital Service, then the sport of politicians, initiated the improvements and growth which have resulted in the present splendid U. S. Public Health Service.

One of America's pioneers in bacteriology was Surgeon General George Miller Sternberg, the author of the first manual (1893) and text-book (1896) of bacteriology as well as important treatises on immunity (1895), disinfection (1900) and infection (1903). He was the first to isolate what was then called the bacillus of croupous pneumonia (1880). He also did important work on yellow fever, and under his administration Major Walter Reed carried out his experiments on transmission of that disease, to be mentioned later. Sternberg, after directing the work of his corps through the Spanish-American War, in the face of legislative and administrative obstacles, established the corps of women nurses, organized the medical service of the new tropical possessions and established the Army Medical School. His service to the public health was attested by his having been elected president of the American Public Health Association as well as of the American Medical Association.

The contributions of the members of the Army Medical Corps to advancement of public health since the Spanish-American War are best understood by selecting for discussion the most important diseases of which our knowledge has been advanced by work of army officers.

TYPHOID FEVER

Typhoid fever was ever the curse of armies in the field, and it seems particularly fitting that army medical officers have taken such a prominent part in bringing it under control.

It is hard to ascertain with accuracy the number of cases in this country prior to the war of 1861, and even in that war such terms as "bilious remittent fevers," "typho-malaria," etc., were used to take the sting out of a diagnosis of typhoid fever, though the latter was made official in 1862 and from that time until June 30, 1866, there were 57,400 cases with 5,360 deaths reported under this name.

With the mobilization of troops for the war with Spain in 1898 this same fever spread rapidly through the camps, though reported under a variety of names. More than 20,000 cases of typhoid fever occurred in the military camps in the United States alone. A board of three medical officers was appointed to study the cause of the epidemics. Its members were Major Walter Reed (who while doing graduate work at Johns Hopkins had already made an important contribution to the pathology of the liver in typhoid fever), Major Victor C. Vaughan and Major Edward O. Shakespeare. Their careful investigations showed that more than 90 per cent. of the volunteer regiments developed the disease within eight weeks after going into camp, that typhoid fever is disseminated by the transference of the excreta of infected individuals to the alimentary canals of others, that camp pollution was a more prominent causal agent in this instance than contaminated water supplies, that the disease was largely spread by flies on the clothing and hands of human carriers, etc. In the epidemic of the Spanish-American War the deaths from typhoid fever were 86.24 per cent. of the total deaths, the morbidity from the disease being 151.05 per 1,000 of mean strength, the mortality being 15.82 per 1,000 of mean strength in a force of 107,973 men. A terrible story indeed!

The British were the first to practice immunization against typhoid fever. Sir Almroth Wright, then a professor in the Royal Army Medical College, began in 1896 to practice vaccination against this disease, the procedure being wholly voluntary. Despite Wright's work protective vaccination was not immediately adopted generally in the British service and in the Boer War of 1899–1902 all the mistakes of the American Army during the Spanish-American War were repeated. Of a total strength of 380,653, there were 57,684 cases and 8,225 deaths, or a morbidity of 151.15 and a mortality rate of 21 per 1,000

Discouraging reports of a "negative phase," following the inoculation against typhoid and unfortunate accounts of higher mortality amongst vaccinated troops in infected areas than in unvaccinated troops at less infected stations, resulted in the prohibition in 1903 of typhoid vaccination in the British service Fortunately Wright's procedure was vindicated by the Royal College of Physicians and again put into operation, and, though it was not made compulsory, 82 3 per cent. of British soldiers in India received the treatment in 1910.

Major Frederick F Russell, of the U S Army Medical Corps (a brigadier general of the reserve since his resignation from the regular army, and general director of the International Health Board), studying the results of British practice, began in 1909 the gigantic experiment of vaccinating the U S Army against typhoid From a morbidity of 173 cases in that year he was able to bring the statistics down to nine cases in 1912 with but one fatal case reported The officers and men who volunteered for his experiments are deserving of the thanks of their countrymen In 1911 he was able to have vaccination against typhoid fever made compulsory and with the mobilization of our troops on the Mexican border in the following year he had ample opportunity to test results in the field. During this mobilization he vaccinated some 20,000 men against typhoid, and the only case that occurred in camp was that of a nonvaccinated teamster Ours was the first army to take this step

Then came the world war. At first the only one of the armies adequately vaccinated was the British In 1914 alone there were more than 45,000 cases in the French army. In 1915 the rate per 1,000 was four for the British, 18 for the Italian and 10 for the Belgian armies. In this year there were more than 64,000 German and 125,000 Austrian cases (strength not known). And so it went. But the practice of protecting their men against this disease became more and more common until all the armies on both sides required it and in the last year of the conflict no army had a rate as high as one The following table for the whole period of the war is interesting:

	Rates per 1,000 per annum	
Country	Morbidity	Mortality
France	14 86	1 81
Italy	6 24	
Belgium	3 59	0 57
Great Britain	1 02	0 04
United States	0.85	0.05

It has not been possible to obtain the accurate strength returns for the German or the Austro-Hungarian armies, but the absolute number of cases of typhoid fever was 112,364 and 171,601, respectively, both figures being higher than the number of cases in any of the allied armies.

Perhaps the most striking way of setting forth the value of the typhoid prophylaxis is to state that had the rates of the Spanish-American War been in effect at the period of the world war, the United States would have had not 1,572 cases of typhoid fever among its soldiers, but more than a half million

YELLOW FEVER

In no disease have members of the Medical Corps of our army done more to advance the sum of knowledge and to reduce to its present restricted geographical limits than this terrible malady Perhaps a better way to put it would be to say that we have the army to thank for our not having the wide spread of "Yellow Jack" that was such a real terror a generation ago The disease is now all but a medical curiosity.

As early as 1793, Benjamin Rush, physician general of the Middle Department of the army, played an important part in fighting the epidemic of yellow fever in his native Philadelphia, and his account of his work is unapproached for its realism

In 1820, Surgeon's Mate Merrill, of the 8th Infantry, outlined a new treatment of this disease, which, while perhaps not in keeping with modern clinical methods, at least had the merit of giving great relief to the sufferers in comparison with the extensive venesection and massive doses of purgatives that had been used up to that time

When Carlos Finlay stated his theory of the insect transmission of yellow fever in 1881, a real step was made, and that great man of science, Surgeon General Sternberg, realizing the desirability of special training in methods of research, sent Major Walter Reed to Johns Hopkins to study pathology under Welch In 1900 Reed was detailed as the head of what is probably the greatest of all army boards. It was to study yellow fever in Cuba, the disease still being supposed to be caused by the so-called *Bacillus icteroides* of Sanarelli It may be remarked here that Sternberg's great contribution to our knowledge of yellow fever was his refutation of the mistakes of other workers and the indication that the causative microorganism of yellow fever was not to be found by ordinary bacteriological methods

The other members of the Reed board were Majors James Carroll, who submitted to inoculation with the disease, Jesse W Lazear, who died from the effects of an accidental mosquito bite, and lastly Assistant Surgeon Aristides Agramonte, a native of Cuba and at present professor of pathology at the University of Havana, the only member of the board still living [Dr Agramonte has died since this lecture was delivered]

In 1900, Surgeon Henry R Carter, of the U S Public Health Service, had shown that a period of 12 to 15 days must elapse before a case of yellow fever becomes dangerous to others This and Finlay's theory were the two principal facts upon which the board had to build I shall not go into the details of the work of the Reed Commission, for the steps in their experiments are known to every student of bacteriological science Dr Turner has set forth the study in an account intelligible and interesting even to the layman Suffice it to say that they were able soon to dispose of Sanarelli's bacillus (found to be identical with the *Bacillus X* of Sternberg) and proceed to attack the problem of transmission by mosquitoes, realizing also that yellow fever could hardly be a "filth disease," since the cleaning up of Havana by the American administration had not improved the situation in that respect They showed that under controlled conditions, the bites of *Aedes aegypti* (then called *Stegomyia fasciatus*) caused yellow fever in volunteers, that the much maligned *fomites* had nothing to do with the transmission of the disease, and that the so-called "infected houses" were such solely because they harbored yellow fever mosquitoes

Comments on the value of the work of Reed and his associates to the world have been many General Leonard Wood, himself a distinguished officer of the Medical Corps and who while in command in Cuba did much to aid Reed, said

> I know of no other man of this side of the world who has done so much for humanity as Dr Reed His discovery results in the saving of more lives annually than were lost in the Cuban War, and saves the commercial interests of the world a greater financial loss each year than the cost of the Cuban War In the months when the disease was ordinarily the worst, it was checked and driven from Havana It was the first time in two hundred years that the city had been rid of it Hereafter it will never be possible for yellow fever to gain such headway that quarantine will exist from the mouth of the Potomac to the mouth of the Rio Grande Future generations will appreciate fully the value of Reed's services

And President Eliot, of Harvard, in admitting Reed to an honorary degree, expressed himself in somewhat the same terms

In his annual report of 1902, the Secretary of War, Mr Elihu Root, said with reference to the conquest of yellow fever in Cuba in 1900

> The brilliant character of this scientific achievement, its inestimable value to mankind, the saving of thousands of lives, and the deliverance of the Atlantic seacoast from constant apprehension, demand special recognition from the Government of the United States

Republics are said to be ungrateful. Certainly they are at times exceedingly slow in recognizing merit. It was not until 1929 that Congress approved an act to present each a gold medal and to publish annually in the Army Register a roll of honor of the names of each member of the Reed Commission and those of the 18 brave men who volunteered for the experiments in the mode of transmission of a disease that was second to none in the terror which it inspired

The task of eradicating yellow fever from Havana fell to Major William Crawford Gorgas, later surgeon general of the army and the best known man who has held that office Gorgas was appointed chief sanitary officer of Havana on February 10, 1900 Under General Wood's orders he instituted the measures now practiced everywhere in combating mosquito-borne diseases He screened yellow fever patients, destroyed mosquitoes, etc, and in three months Havana was freed from the disease for the first time in 150 years

The success of Gorgas in Havana led naturally to his being put in charge of similar work in the newly acquired Canal Zone in 1904 Here what had been a notorious plague spot of disease, the "White Man's Grave," as it was called, was converted into one of the healthiest communities in existence Gorgas continued the methods which had proved so successful in Havana In the face of much stupid opposition at first, Gorgas never hesitated in attaining his objective, that of making the isthmus free from disease before the operations on the canal were commenced While the elimination of other diseases was no less important than that of yellow fever, this malady comes first in the minds of the general public Under the French occupation it was a byword that every tile laid on the Panama Railway cost a life From 1881 to 1889 the French lost more than 22,000 laborers by death, an annual rate of 240 per thousand. One station on the old Panama Railway was called "Matachin," from the Spanish words *matar* (kill) and *Chino* (Chinaman), because 1,000 imported Chinese coolies at this point died off in six months, as did also 1,000 Negroes from the West Coast of Africa.

When the United States took charge of Panama the death rate was 40 per 1,000. A yellow fever epidemic raged from July, 1904, to December, 1905. In less than a year Gorgas had eradicated it entirely and there has not been a single case of the disease there since May, 1906.

In one of his reports Gorgas said

> When the Canal shall have been finished it can be shown that sanitation cost about $365,000 per year. For

a population of 150,000, this means an expenditure of about one cent per caput per day, and this sum is well within the means of any tropical country

Elsewhere he says

> I do not believe that posterity will consider the commercial and physical success of the Canal the greatest good it has conferred upon mankind I hope that as time passes our descendants will see that the greatest good the Canal has brought was the opportunity it gave for demonstration that the white man could live and work in the tropics, and maintain his health at as high a point as he can, doing the same work, in the temperate zone That this has been demonstrated none can gainsay

In 1906 during the period of our second intervention in Cuba, Major (now Brigadier General, Ret) Jefferson R Kean, a medical officer who had already been commended for his work in helping the Reed Yellow Fever Board, and curiously enough, the first yellow-fever patient that his friend Reed had ever seen, was placed in charge of sanitary affairs in the island by President Taft This position he held throughout the entire period of occupation, and during this time he extinguished yellow fever, which had reinvaded the island during the first Cuban republic, and owing to the great increase in the non-immune population had spread all over Cuba In 1900, when yellow fever had been extinguished in Havana, it disappeared from the entire island

During the remainder of his life, even while he was surgeon general of the army, Gorgas was frequently called to distant parts of the tropical world to give advice and assistance After his retirement from active duty, after having served as surgeon general through the world war, he was on his way to South Africa for the purpose of taking up yellow-fever work for the International Health Board, when, delayed in Europe by the award of many honors, he died suddenly in London, having been knighted on his deathbed by King George V As Colonel Ashburn said, "He was a verray parfit gentil knyght"

The preventive measures used by Reed and Gorgas have been, and are being put into effect in many tropical lands In his recently published report on "Twenty-Five Years of American Medical Activity in the Isthmus of Panama," a work received with enthusiasm in Britain, France and elsewhere, Colonel Weston P Chamberlain, health officer of the canal, says

> **By far the larger part of the morbidity and mortality formerly attributed by tropical *climates* was due, not to climate *per se*, but to isolation, nostalgia, venereal disease, alcoholic excess, poor municipal conditions, and, most important of all, *to infection with specific parasites whose invasion is now entirely preventable* . . .**

Commenting on which, Sir William Horrocks remarks, "This may justly be regarded as a triumph of preventive medicine."

MALARIA

Malaria has always been a disease of the greatest interest to the medical officers of all armies and certainly the greatest advances in our knowledge of the malady have been made by men of that profession. On November 6, 1880, Alphonse Laveran, a medical officer of the French army, discovered the parasite of malaria while serving with the troops in Algeria and in the following year described them in all their aspects His four great treatises on palludism are classics In 1897 Sir Ronald Ross, of the Indian Medical Service, then a major, demonstrated the anopheles mosquito as the vector of malaria, discovered the Laveran plasmodia in the stomach wall of anopheles which had fed on the blood of malarial patients, proved that one stage of the parasite is found in the salivary glands of the insect and devised methods of destruction of the insects, which he employed with success in mosquito reduction in Sierra Leone, Lagos, the Gold Coast and Ismailia Both of these officers were awarded the Nobel Prize and other high recognition of their work

But it was the Americans who gave the greatest demonstration of anti-malarial work From 1898 onward our troops were instructed to use mosquito nets and otherwise how to avoid infection—the first army to adopt this measure The work of Gorgas in Havana was directed mainly to the prevention of mosquito-breeding During the same period when the yellow fever was being abolished in that city, its malarial incidence was reduced 75 per cent Later the same administrator obtained the same results in Panama

Malaria, as we all know, is not as easily eradicated as yellow fever because *Anopheles* (*Anopheles*) is not a domestic insect, as is *Aedes*, and the malarial patient, instead of being capable of giving the infection to the mosquito for three days only, as is the sufferer from yellow fever, is dangerous for weeks, months or even years Malaria patients are also far more numerous than yellow-fever patients

But the work goes on and witness the results thus far In 1901 the incidence of malaria in the U S Army was 381 per 1,000, in 1902 it was 272; in 1907, 85; in 1926, eight, and in 1927, six, and for last year it was again six, and this is true even with the increase in malarial incidence following the floods of the Mississippi Valley.

Another medical officer whose work in malariology has been important is Colonel Charles F. Craig, who demonstrated that the intra-corpuscular conjugation in the malarial plasmodia is the cause of latency and relapse, and of the existence of carriers

HOOKWORM DISEASE

In 1900 Captain (now Colonel) Bailey K Ashford, U S Army, discovered the great prevalence of hookworm disease in Porto Rico, and shortly thereafter it was found to be very prevalent among the rural population of the United States, by Dr Charles Wardell Stiles, of the U. S Public Health Service, who described the American hookworm, *Necator americanus* Ashford devoted himself to the task of stamping out hookworm infection in Porto Rico and in 1903–4 treated some 300,000 patients, reducing the mortality by 90 per cent This determination of the mode of combatting the long-dreaded "Porto Rico anemia" must be rated as a notable achievement in American hygiene.

BERIBERI

When we took possession of the Philippine Islands our medical officers met for the first time the disease beriberi, a peculiar peripheral neuritis all too well known in the East Many men died of it, particularly in the Bilibid Prison, in Manila and in the newly organized Philippine Scouts It had been the scourge of the Japanese armed forces, but they had freed their navy from it by changing the rations of the men In 1909, the U S Army Board for the Study of Tropical Diseases recommended that the ration of the Philippine Scouts be changed by the substitution of unmilled for the previously used highly milled rice, a substitution of beans for a part of the rice component of the ration and the prohibition of savings in the meat element of the ration The admission rate for beriberi as a result fell from 604 in 1909 to 50 in 1910 and two in 1911, and it has been absent, or nearly so, ever since

Later on, one of the members of the board, Captain (now Colonel) Edward B Vedder, continued his studies of beriberi, including the infantile form, and his excellent monograph on the subject won him the Cartwright Prize in 1915

TYPHUS AND TRENCH FEVERS

Typhus Fever During the great war and the period which followed, American medical officers played an important rôle in campaigns against typhus fever, the age-old scourge of armies. Twice in Serbia, in 1915 and 1919, the epidemics of typhus, the most severe that the world had ever known, were brought under control Almost as striking results were obtained in Poland.

Trench Fever· The American Red Cross Medical Research Commission showed that this disease, a common cause of non-effectivity in the world war, was due to a filterable virus and transmitted by body lice. The members of the American commission were medical officers of the army under the direction of Major Richard P. Strong, formerly of the regular service, and then a reserve officer

Malta Fever· In 1898 Lieutenant Walter Cox first described Malta fever in the U. S Army, and in 1911 Captains (now Lieutenant Colonels) Gentry and Ferenbaugh showed the disease to be endemic in our Southwest

PHYSIOLOGY OF DIGESTION

"Every physician," says Vaughan, "who prescribes for digestive disorders and every patient who is benefited by such a prescription, owes gratitude to the studies of William Beaumont, who in 1825, on the Island of Mackinac, began his studies of digestion, which he pursued with labor and skill for the benefit of mankind," making what Harvey Cushing calls "the most important contributions to the physiology of digestion made during the century"

Beaumont, a surgeon of the U S Army, described his lengthy study of an accidental gastric fistula in the Canadian half-breed, Alexis St Martin His "Experiments and Observations on Gastric Juice and the Physiology of Digestion" is a classic known to every student of physiology He carefully reviewed the work of his predecessors, gave an accurate description of the normal and pathologic appearance of the gastric mucosa in life, the movements of the stomach up to the completion of digestion, showed that the gastric juice is secreted only when food is present and that mechanical irritation of the mucous membrane produces congestion, but only a limited local secretion of gastric juice, thus foreshadowing the work of Pavloff and overthrowing the doctrine of Magendie that gastric secretion is continual. Beaumont's experiments on the effect of gastric juice upon different foods and the relative nutritive values of the latter are in reality the foundation of modern dietetic tables, while his chemical examination of the gastric juice led him to the conclusion that it contains free hydrochloric acid plus some other active chemical substance, proved later by Schwann to be pepsin. The story of Beaumont's efforts to keep in touch with his temperamental patient, his expenditure of his own limited funds in his experiments, and his single-handed work, constitutes one of the most romantic episodes in the history of medical science. Beaumont served through the war of 1812 as a surgeon's mate and later was a surgeon at Fort Mackinac, Michigan, a frontier post frequented by Indians and trappers, where he met his patient, St. Martin. Beaumont General Hospital, U S Army, at Fort Bliss, Texas, was named in honor of this great medical officer.

Of Beaumont, Sir William Osler said, "His work remains a model of patient, persevering investigation, experiment and research, and the highest praise we can give him is to say that he lived up to and fulfilled the ideals with which he set out and which he expressed when he said, 'Truth, like beauty, when unadorned is adorned most, and in prosecuting these experiments and inquiries, I believe I have been guided by its light'" Osler himself planned to secure St Martin's stomach for the Army Medical Museum, but when that celebrated patient died in 1880, an old man and the father of 20 children, Osler received a telegram, "Don't come for autopsy, will be killed," and St Martin's neighbors guarded his grave by night.

Purification of Water

Brigadier General Carl R Darnall, then a major, devised the first apparatus for the use of chlorine gas in the sterilization of water and was the first to apply liquid chlorine to this use. His priority is attested by basic patents in this as well as other countries, the validity of which has been upheld in the courts His experimental work was carried out at the Army Medical School, of which he is now the head.

The Darnall filter was an important step in the solution of the problem of supplying potable water to troops in the field The Lyster bag, devised by Colonel W. J Lyster, for the chlorination of water in the field by means of calcium hypochlorite, is known to every person who has been in the army since the days of the Texas Border mobilization, and is still the most satisfactory method for this purpose It is widely used in camps, not merely those of a military nature.

Meteorology

Meteorological data in the United States were first recorded by the medical department of the army in 1814. In 1819 Surgeon-General Lovell directed that the medical officers at each post record weather observations. Beginning with temperature readings only, there were soon added data on rainfall, wind direction, sunshine, cloud formation and precipitation of rain or snow. From these records in later years tables of mean temperature for different localities were prepared, and there followed the construction of weather maps by Espy, which became the forerunners of the Weather Bureau Maps of to-day.

In 1870 Surgeon Albert J. Myer, for whom Fort Myer was named, created the signal corps of the army and became the first chief signal officer. The Signal Corps took over the meteorological records that had been kept by the Medical Department, and continued them until 1890 when the Weather Bureau of the Department of Agriculture was instituted and undertook meteorological work for the country.

Periodic Physical Examinations

The annual physical examinations of army officers, recommended by the Medical Corps and put into effect in December, 1907, by order of President Roosevelt, was the first step towards a measure long practiced in the army and now universally recommended by public health agencies.

Public Health Education

I have already said that the medical department of the University of Pennsylvania, oldest medical school in America, was founded by two medical officers of the army, Morgan and Shippen, so from the first the Medical Corps has been a contributor to the cause of education

In 1893, without any legal authorization, Surgeon General Sternberg established the Army Medical School, using at first the rooms in the building which then as now houses the Army Medical Museum and Army Medical Library He detailed the faculty from officers having other duties in Washington, and in his choice of his instructors he, the great bacteriologist, chose wisely It is not too much to claim that this institution was the first school of hygiene in America.

Later years have fully justified the inception of the school. Though there have been obvious and logical changes in its curriculum and methods of instruction, it has been, in general, used to give special instruction to young physicians just after receiving their commissions in the Medical Corps. For a long time they attended the school on a sort of probationary status (sometimes as contract surgeons, sometimes as officers of the Medical Reserve Corps, etc) and on satisfactorily completing the course of one academic year, they received commissions as first lieutenants in the Medical Corps of the regular army More recently an advanced course has been added for officers of field rank. Both courses stress preventive medicine, modern laboratory methods, tropical medicine, hygiene of troops on the march and in the field and the elements of sanitary engineering, that meeting ground of military and civil engineering In 1923, the new and modern school building was opened at the Army Medical Center in Washington, near Walter Reed General Hospital, and the institution compares favorably with others of its type, such as the Royal Army Medical College at Millbank, London, and the French School of Application at the Val-de-Grâce medical center in Paris.

Shortly after the close of the great war, Congress authorized the army to detail officers, not exceeding 2 per cent. of the total commissioned strength, to scientific institutions of higher learning, for the purpose of pursuing courses of instruction in professional fields that would enable them better to perform the duties of their grade and corps. The Medical Corps has, under the law, detailed officers of the Massachusetts Institute of Technology and the schools of public health of Johns Hopkins University, Harvard University and the University of Pennsylvania So far a total of 26 officers have had the benefit of such advanced work, i e, in public health alone A fair number of our officers have also completed the course at the London School of Tropical Medicine

Another post-war development in the education was the Medical Field Service School established at Carlisle Barracks, Pennsylvania, in what had once been the Carlisle Indian School Here both officers and men are given training in the military duties of medical officers and practical instruction in such subjects as field sanitation, military preventive medicine, sanitary engineering, etc Here also is a special laboratory for the development of equipment and devices for use of the Medical Department of the army

In the Philippine Islands there is maintained an important research body—the U S Army Medical Research Board It was established in 1900 at the period just following the Spanish-American War, when the army found itself responsible for the government and health of several tropical dependencies, particularly the Philippines The high incidence of tropical diseases constituted a menace to the army of occupation and interfered seriously with administration of the newly acquired territory

The first members of this board were Lieutenants Richard P Strong (now professor of tropical medicine at Harvard), W H Calvert, Assistant Surgeon Joseph J Curry and Hospital Steward Dr W E Musgrave They issued in 1901 a valuable outline of the steps that should be taken to prevent the spread of plague, and by means of which the disease was controlled in Manila and kept out of the army This was before the excellent work of the Indian Plague Commission had demonstrated the agency of the flea in the transmission of the disease

The work of this board has solved many problems of wide interest in the field of public health These include important contributions to the sum of our knowledge of cholera, typhoid fever, uncinariasis, yaws, leprosy, epizootic lymphangitis in horses, malaria, filariasis, etc They showed, for example, that the long-known "hill diarrhoea" was due to the Flexner type of dysentery bacillus One member (Vedder) demonstrated the amoebicidal action of ipecac (used theretofore empirically), and proved that it was due to the alkaloid emetine. He further showed that this compound is of no value in bacillary dysentery They showed that diphtheria is far more prevalent in the tropics than had been thought. They pointed out that tuberculosis is two and one half times more common in Filipinos than in Americans. They demonstrated that the horsefly *Tabanus striatus* is the common vector of surra, the most serious disease of horses in the Philippines An improved vaccine for rinderpest was produced They proved that canning does not destroy the anti-scorbutic vitamin, a discovery of importance since scurvy was not uncommon Vedder's work on beriberi has been mentioned

The board first showed (1925) that the infective virus of dengue is in the circulating blood and that the disease is transmitted by the mosquito *Aedes aegypti* This was a fitting climax to long work by members of the Medical Corps, begun by Benjamin Rush, who first recognized and described this disease a century ago, and continued since that time by many workers, notably, Colonels Charles F Craig, Percy M. Ashburn, Joseph F Siler and others

In the field of climatology, it was shown that the effect of tropical light on white men is no more deleterious to blondes than to brunettes

Another important army educational institution is the Army Medical Library Billings founded what was long called the Library of the Surgeon General's Office, as has been said This collection of the literature of the medical sciences is one of the greatest in existence It contains more than a million items, subscribes to some 1,500 journals, and publishes what has been called America's greatest contribution to medicine, i e, the Index Catalogue of the library and the Index Medicus The Index Catalogue lists the medical literature of the world as classified and filed in the library It has completed two alphabetical series and the third series to include the letter P, and thus far embraces 45 volumes of octavo size and about 1,500 pages each This catalogue is used throughout the civilized world As a period of 15 to 20 years is necessary for the completion of an alphabetical series, a given subject, for example, typhoid fever, will appear but once in that time. To supplement the catalogue and enable the investigator to locate references to his subject in the current literature, Billings began the Index Medicus, a monthly index of the new medical books and articles appearing throughout the world. Unlike the Index Catalogue, which is a government publication, the Index Medicus never was and it always lost money The expenses were for a long time defrayed by the Carnegie Institution and it is now continued as the Quarterly Cumulative Index Medicus of the American Medical Association, a necessity as well as a blessing to the medical investigator and writer.

In this library, Colonel Fielding H. Garrison, the best-known American authority on the history of medicine, has spent his life and done his work. Since his retirement from active service he has been librarian of the Welch Memorial Library at the Johns Hopkins Schools of Medicine and Hygiene.

Unfortunately, the scope of my talk to-day does not permit of a description of Munson's experiments on the footgear of the soldier and his development of the "Munson last" for shoes, now in use in our own and several other armies, of his important work on leadership and his directorship of the morale branch of the general staff during the world war, of Lagarde's valuable work on gunshot wounds in which he disproved the old idea that wounds from bullets are sterile, of Letterman's system of the evacuation of the wounded, a revival of the work of Larrey, surgeon-in-chief of Napoleon's *Grande Armee*, and many others

One might likewise note the work of distinguished medical officers in other branches of the army I have already spoken of the creation of the Signal Corps of the Army by Surgeon Albert J Myer in 1870 Major-General Leonard Wood, a great military leader and chief of staff of the army, was an officer of the Medical Corps, as was also, and at the same time, the adjutant general of the army, Major-General Fred C Ainsworth, who devised the present system of record keeping More recently an officer of the Medical Corps, Major General Harry L Gilchrist, after having distinguished himself in research in his chosen field, was appointed chief of the Chemical Warfare Service He is a national authority on the effects of chemical agents on animal life and his knowledge is of great benefit to industry as well as in the protection of human life.

It is hoped that I have given the impression that medical officers of our army have by their achievements held their own in comparison with the great medico-military officers of other nations, such as John Hunter, Sir Ronald Ross, Sir William Leishman (sometime director of the British Army Medical Services), von Graefe, Vincent of angina fame (sometime director of the French Army Medical Service), Helmholtz, Cohnheim, Loeffler, von Behring, Laveran, Widal, Pirogoff and others.

I think also that it will have been seen that what our branch of the United States Army has done compares favorably with the so-called "civil" accomplishments of the army as a whole, such as the digging of the Panama Canal, the construction of early railways, the building of the Capitol, Washington's Monument, the Library of Congress, etc., in Washington, the Lewis and Clark Expedition to the Northwest Territory, the expedition of Pike (of Pike's Peak), rivers and harbors work, the conduct of affairs after the San Francisco earthquake and the rest.

Sir Thomas Lewis recently pointed out that not only may medicine be divided into the usual divisions of individual and collective medicine, that is, general practice and public health, but public health itself may be divided into curative preventive medicine or herd treatment, and progressive preventive medicine or herd-pathology In pure curative medicine the diagnosis is the main end-point whose object is to recognize the known in order to administer the correct established remedy The worker in pure progressive medicine has no interest in the known except as a starting point to reach out into the unknown To the scientific investigator the individual, or even the community, is of no importance or interest unless as material to help the progress of scientific medicine In so far as he is allowed any humanitarian interests at all, the researcher works largely for the future and is glad if during his lifetime any of his work should prove useful in presenting applied medicine with new methods of diagnosis or treatment

The Medical Corps of the army, as well as some of the other federal departments, offers an exceedingly attractive field to him who has the craving for research, who yet is not sufficiently enthusiastic to slave for the best part of his life in a laboratory in the average research position with its, for shame be it said, comparatively low financial return Though in the service it is the medical officer's duty to give his first attention to the practice of preventive and curative medicine, he may also find plenty of time and encouragement from those in authority over him to carry on research The income of the medical officer of the army is not large—I shall tell you in a moment just what it is—but it has one great advantage. It is not liable to be altered or suddenly cut off through the whim of a politician, or the turn of the wheel of chance. It is, as I once heard an old Kentucky judge remark about his salary, which was notably less than he might have earned in the practice of law. "It's not much, but it's awful regular"

The medical officer of the army enters with the grade of first lieutenant That he does not begin with the lowest grade in the military scale of rank is a recognition of the long period of study that he must spend in preparation The pay of the first lieutenant, including all allowances, averages approximately $3,100 per year After three years he is promoted to captain and receives $3,900 per year After 12 years he becomes major and receives $5,500 In 20 years he is a lieutenant colonel, with a salary of $7,200 and in 26 years as a colonel he receives $8,000. Promotion beyond that rank is by selection.

The medical officer, particularly the medical officer engaged in public health work, is one of the army's best contacts with the civil community. Balfour says, "If the International Health Board of the Rockefeller Foundation had not the word 'health' in its title, its manifold activities would never have been received with complacency and gratitude by countries not owing allegiance to the Stars and Stripes" That word "health" is a talisman which can successfully unlock many a domestic as well as foreign door. There are occasions when civil authorities do not cooperate in a satisfactory manner with the military, particularly in times and places where there is a real or possible overlapping of authority But it is hard to imagine a situation in which there is friction between the military and civil officers of health Indeed, many a wise military commander has, by means of the friendly relations between the medical officers of such commands and their civilian colleagues, brought about a complete understanding and team work with civil authorities.

"The Services," says Dudley, "are the happy hunting ground, and one of the last strongholds of the amateur researcher The word amateur here is used in its literal sense, not one who does something worse than a professional, but one who does something for the love of doing it. We may only be amusing ourselves, but if something useful emerges from our pastime so much the better, but that is not the main object of amateurs While we may not wholly agree with the professor who at the end of a lifetime spent on some academic research said, 'Thank God I have never done anything practical,' yet in these sordid times one can not but sympathize with his sentiment"

When the medical officer of to-day thinks of what his predecessors have been able to achieve, of what practical good has come of their experiments, amateurish though they may at times have been, for all have not the facilities of the Army Medical School, the Tropical Board, etc, within reach, of the outcome of patient observation, of the productive results of the application of scientific principles and sound logic he may, with a feeling of pride and hope, continue his task in the realization that his efforts are not only "for the good of the service," to use a military catch-phrase, but likewise for the good of the whole nation

OBITUARY

RICHARD ALEXANDER FULLERTON PENROSE, JR.

December 17, 1863–July 31, 1931

The well-traced roots of the Penrose family, one might more accurately say clan, thread their way back to Cornwall before William the Conqueror sought the shores of Britain For hundreds of years the name of Penrose is intertwined with the activities of that land, and in many instances it stands out conspicuously, whether in the field of knighthood, in law, in diplomacy, in religion, in politics, in education, in commerce or in battle by land or sea They were also a daring and venturesome people and not at all averse to seeking opportunity in distant lands.

At the seaport of Bristol, in Gloucestershire, England, there lived one Bartholomew Penrose, who with his brother Thomas conducted a ship-building business Much direct trading with Philadelphia was carried on from this port and it was but natural that stimulating stories of the possibilities of the new land over seas and the great success which was being achieved under the guidance of William Penn should have reached the ears of young Bartholomew and made him eager to go adventuring. About the year 1700 he landed in Philadelphia, and having an excellent social standing and skill in ship-building and sea commerce, he was soon well married and launched on a prosperous career. Thus was the Penrose strain transplanted in Pennsylvania, and whether in public or private life its achievements and rewards in the new world equalled those in the old High mentality, combined with sound business sense, seems to have been the dominant characteristic of the Penroses wherever they were found and under whatever conditions they lived.

With such a background there came, in the seventh American generation, to Richard Alexander Fullerton Penrose and his wife, Sarah Hannah Boies, at the old homestead, 1331 Spruce Street, Philadelphia, on December 17, 1863, a fourth son, who was named after his father This boy was richly endowed with the best of the Penrose ancestral traits, and he seemed to have missed out completely in respect to any undesirable qualities which may have existed in his forebears. His was preeminently a scientific mind, and, though engaging in many mining activities which had their roots deep in geology, he never lost his keen and active interest in this department of science. It always occupied the first place in his long and useful scientific life.

He graduated, with highest honors, from Harvard in 1884, and became a member of the Phi Beta Kappa Society. He remained at Harvard for postgraduate work till 1886, receiving the degrees of A.M. and Ph.D. It is noteworthy that his thesis for the latter degree, "The Nature and Origin of Deposits of Phosphate of Lime," was promptly published by the U. S. Geological Survey. A complete bibliography of his many writings will appear in the memorial to his memory in Vol 43 of the *Bulletin* of the Geological Society of America, with which he was intimately connected from 1889 until his death and of which he was elected president in 1930

On leaving college he took up active field geology, as shown by the following quotation from a statement prepared in his office before his death

> In 1888 he was Geologist in Charge of the Survey of Eastern Texas for the Texas Geological Survey, in 1889 he was appointed by the Geological Survey of Arkansas as Geologist to make investigations in the geology of the manganese and iron ore regions of that State, in 1892 he was appointed Associate Professor of Geology at the University of Chicago, and in 1895 he was made full Professor of that subject at the same university He was lecturer on Economic Geology at Stanford University, California, in 1893, and in 1894 he was appointed Special Geologist of the United States Geological Survey to examine and report on the gold districts of Cripple Creek, Colorado Still later he was engaged in geological work in different parts of the United States and in various other countries and in the pursuit of his investigations he visited almost all the countries in Europe, Asia, Africa, South America and elsewhere One of his most elaborate trips was across Siberia before the Trans-Siberian Railroad was completed

Dr. Penrose was connected through memberships and otherwise with at least two score of scientific organizations devoted to research or publication, his especial favorites being the American Philosophical Society and the Geological Society of America.

He combined with his fine scientific attainments a keen sense of sound business methods and a complete knowledge of the pecuniary rewards to be obtained from walking wisely in the market place. He even went so far in the business world as to accept half a dozen directorships, but they were in enterprises intimately related to his many interests in the field of mining. Soon after leaving college he had interested himself in copper deposits from a commercial as well as a scientific standpoint. He knew every copper district in the world, and when a new field was discovered he usually visited it personally or otherwise made himself thoroughly familiar with its character and possibilities. He was well acquainted with security values and the influences affecting them, as evidenced by the fact that he left an estate of approximately ten million dollars. After payment of all taxes, obligations and bequests there were available about eight and a half million dollars for distribution equally between the American Philosophical Society and the Geological Society of America. A rare combination indeed of scientist and financier.

Why he chose to lead a single life, only he knew. He was a man of great personal charm, gentleness of nature, courtly address and irreproachable life Apparently geology was his first and only love. There seemed never to have been any wooing time for him. He was a member of a number of well-known clubs, but in no sense was he a club man The old homestead in Spruce Street provided him a fireside, though in later life he occupied a suite of rooms in the Bellevue-Stratford in Philadelphia, where he was protected from intrusion and could come and go at his pleasure and on a moment's notice

Dr. Penrose lived a full, rich life He was not only a devoted, high-minded scientist but a genial enlightened gentleman with whom it was a pleasure to associate and a benefit to have known Even in his last hours his thoughts were of the two societies to which he was so deeply attached and he so ordered his estate that they could both carry on in fuller measure and further advance the welfare of the world through research

JOSEPH STANLEY-BROWN

At a meeting of the council of the Geological Society of America, held at Columbia University, New York, on October 17, the following resolutions were unanimously adopted.

Be it Resolved,

That in formally recording, in the minutes of this meeting, the death of Richard Alexander Fullerton Penrose, Jr, The Geological Society of America, through its Council, desires to express its deepest regret that he should not have been spared for many more years of useful work, and also its high appreciation of his fine personal character and his exceptional attainments in the field of geology By his individual efforts and through his ever ready and generous cooperation with others, he did everything in his power during a long and successful life to promote activity in the field of research so dear to him.

Be it further Resolved,

That the society recognizes, with profound gratitude, that in carrying out a high ideal he has made it possible, through his magnificent generosity, to further advance in a large way, even after death, the science to which he devoted his life. In his last hours his thought was for the Society and he has not only handed to it a flaming torch but the means for keeping its sacred fire forever burning. Such a trust carries, in thought and deed, an obligation of loyalty such as Dr Penrose always gave to the Society and to his colleagues

And be it further Resolved,

That an engrossed copy of these resolutions be forwarded to Mr. Spencer Penrose, the sole surviving member of the immediate family.

RECENT DEATHS

Dr. Olin H. Landreth, professor of engineering at Union College from 1894 to 1919, when he was appointed professor emeritus, died on November 5, aged seventy-nine years. Previous to 1894 he had been professor of engineering and dean of the engineering department at Vanderbilt University.

Dr. Edward H. Jenkins, director emeritus of the Connecticut Agricultural Experiment Station, died at his home in New Haven on November 7 at the age of eighty-one years.

Mr. Lewis Taylor Robinson, engineer in charge of the general engineering laboratory of the General Electric Company, died suddenly from a heart attack at his home in Schenectady on November 3. He was sixty-three years old.

The death is reported from Dresden, at the age of sixty-six years, of Professor Dr. Ing. Fritz Foerster, who had been connected with the Dresden Technical Institute for the past thirty-one years.

The *British Medical Journal* reports the deaths of the following medical men: Dr. Louis Goudard, a former president of the Medical Society of Paris; Dr. Ducamp, professor of clinical medicine at Montpellier; Dr. A. Besson, of Paris, author of a work on microbiological and serotherapeutic technique, and Dr. Piana, for twenty-five years director of the Radiological Institute of Genoa.

SCIENTIFIC EVENTS

THE BERMUDA FRESH-WATER SYSTEM

The first fresh-water system in the history of Bermuda, regarded for centuries as impossible of achievement, will be opened for public use on November 30, according to Professor W. D. Turner, of the department of chemical engineering at Columbia University, who planned and directed the construction. He states that drain water caught on the house tops and frequently polluted to a high degree, has served the residents of the island for generations. New York's water supply would be condemned if it contained as much as one *Bacillus coli* per cubic centimeter, while water is considered good in Bermuda if it contains not more than 100.

Professor Turner writes:

> In Bermuda most of the rock is of porous coral, filled with small cavities and fissures. After a survey of the island we selected a small hill near Hamilton, capital of the colony, believing that the fresh water filtering through the rock crevices might be collected. A trench about 250 feet long and four feet deep was dug at the base of the hill. The bottom of the excavation was approximately a foot above sea level and sloped gradually to a pump pit.
>
> A pipe line was laid in the trench with open joints so that water might find its way into the pipe and thence to the basin or pit. By concreting the basin, which, of course, was dug below sea-level, we prevented sea-water from seeping in. This was one of the points which was overlooked in previous attempts to tap a fresh water supply.
>
> From the collecting basin the water will be pumped into a new reservoir which is practically completed at Pymwood, near Hamilton. From that point the supply will be piped to the capital city and perhaps to St. George's, the old capital, twelve miles from Hamilton.

After the trench was covered over and the basin complete, Professor Turner tested his "horizontal well." For three months a two-inch stream was pumped out of the pipe line day and night. The water was allowed to gush over a nearby golf course. New Yorkers use three times as much water as the residents of Bermuda. Hotels are the largest consumers on the island because of their American guests. The capacity of the island system is 300,000 gallons. In the United States this supply would meet the demands of a community of 3,000 persons. The population of Hamilton is 6,000, but because of the conservative use of water in Bermuda the new system will more than meet the demand. Since they have been using rain water for 300 years, the people are used to very soft water. In order to meet this requirement, the new system will include a water-softening plant, which will also remove the soil bacteria. The hardness is due to carbonate and hence can be removed by lime. The average rainfall is 60 inches annually, approximately the same as that of New York and New Jersey. It is estimated that the trench will collect about 50 per cent. of the water-fall. The well may be extended to increase the supply in event of additional demands.

The new water system, which will be known as the Bermuda Water Works, was financed by Mr. H. W. Watlington, philanthropist and a member of the House of Assembly. Construction work was started in the summer of 1930.

TOPOGRAPHICAL MAPS

The U. S. Coast and Geodetic Survey, with the aid of time signals sent from the U. S. Naval Observatory, is planning to utilize the stars at several points along the Mississippi River for scientific calculations. The expert in charge of this work, Mr. Joseph P. Lushene, will use the data from his observations to adjust an arc of triangulation from Chester, Illinois, to St. Paul, Minnesota. These arcs of triangulation are of importance to engineers and others in private industry. Engineers can get exact geographical information of a piece of ground, as to its elevation, latitude and longitude, that would cost large sums of money if this work were to be carried out by the individual

The survey engineers have been engaged for a number of years on a "triangulation plan" of the 3,000,000-odd square miles of the United States, setting bronze markers at various points in order to fix the basis for a system of topographical maps which will be available to any engineer or scientific man

Mr Lushene will call to his aid another branch of science, the radio, in helping him to simplify his observations and calculations With the aid of a radio, complicated scientific observations, ordinarily taking two or three nights, can be completed in a single night

Longitude determinations, which are made by comparing the time from observations on the stars as they pass the meridian at the field stations with the time signals sent from the U S Naval Observatory in Washington, are exceedingly accurate This comparison gives the difference in time between the seventy-fifth meridian and the field station, and the difference in longitude thus becomes known

A single observing party is all that is now needed in the field, while before the radio came into use, it was necessary to have two observers, one at a point whose longitude had previously been determined and the other at the new station The stations had to be placed within a reasonable distance of a telegraph line, for otherwise great expense would be involved in connecting by wire the telegraph line and the observatory

This meant very little freedom of choice in the location of the longitude station, and the triangulation often had to be expanded in order to make connection with the astronomical station With the radio there is no restriction as to the location of stations except that high mountain peaks are not used for longitude determinations because of the difficulty of carrying the instruments to the top In general, stations are used to which the automobile truck that carries the astronomical instruments can be driven.

The radio is of value not only to the geodetic engineer in the determination of longitude, but for the same purpose to the navigator of a ship. To-day the navigator can use an ordinary pocket watch, receive his time signals by radio and be able to determine his longitude with greater accuracy than previously, when he had to depend on the constancy of the rate of the chronometer.

THE AGRICULTURAL EXPERIMENT STATIONS

Funds for the support of the agricultural experiment stations "are being carefully safeguarded and, to an increasing extent, restricted to intensive and productive research," according to the annual report of the Office of Experiment Stations, made public on November 6 by the U S Department of Agriculture The report states that 1,000, or more than 15 per cent, of the 7,000 or more distinct lines of agricultural investigations in which the stations are now engaged are carried on in cooperation with the department, thus extending the scope and increasing the efficiency and usefulness of the work

The report shows that federal, state and other funds, amounting to about $18,000,000, of which $4,340,000 was available from federal sources, were expended by the experiment stations in the year ended June 30, 1931, in a wide range of agricultural research

Stations in Alaska, Hawaii, Porto Rico, Guam and the Virgin Islands report progress in efforts to diversify the agriculture of these regions and to make it more profitable and self-sustaining The appropriations for these stations for the year were Alaska, $85,300, Hawaii, $45,200, Porto Rico, $59,200, Guam, $30,200, and the Virgin Islands, $30,300 The Virgin Islands station received in addition $16,700 from other sources for use in expanding its work to meet emergency conditions on the islands

An important event of the year affecting the Alaska experiment stations was the transfer of the station which has been in operation at Fairbanks since 1907 to the Alaska College of Agriculture and School of Mines, thus giving the local institution greater participation in the experimental work

Coordination of the work of the former federal experiment station in Hawaii with that of the University of Hawaii is reported to be proving satisfactory and to be resulting in a widening of the field of activity and an increase of interest in the work

The report points out that Congress recently extended to Porto Rico in a modified form the Hatch, Adams and Purnell Acts The acts provide that the work of the existing experiment stations and the activities of the U S Department of Agriculture in the island shall be coordinated by the Secretary of Agriculture and conducted jointly and in collaboration Preliminary steps were taken to bring about this coordination

The Guam station reports continued success in efforts to bring about diversification of the agriculture of the islands and to develop extension work. Following the establishment of a civilian government in the Virgin Islands, and in view of the serious economic and food conditions in the islands, the experiment station suspended some of its usual activities and devoted its energies to encouraging the people to plant and cultivate gardens as a relief measure.

Steps were also taken to improve the bay-oil industry and to reestablish the growing of cotton.

A NEW HARVARD OBSERVATORY

According to an article in the *Harvard Alumni Bulletin* the Harvard College Observatory will have in the near future a new astronomical observing station on Oak Ridge in the town of Harvard, Massachusetts, 27 miles northwest of Cambridge The station will be on a ridge at an altitude of 600 feet, the highest point between Mt. Wachusett and the sea The site is the gift of Mr and Mrs Alfred C Fuller, of Belmont

At this station the new 60-inch reflector telescope, the largest astronomical instrument in the eastern part of the country, will be the most important part of the equipment, but five or six of the observatory's photographic telescopes will be moved from Cambridge to the new station Four photographic telescopes and the visual telescopes will be retained and operated at the headquarters on Observatory Hill, Cambridge.

It is estimated that telescopic power will gain on Oak Ridge a whole magnitude beyond that obtainable at the present site in Cambridge This difference in brightness corresponds to a doubling of the number of stars within the reach of the various photographic telescopes

The construction on Oak Ridge will include the building and turret for the 60-inch reflector, three buildings for the other telescopes, and a central building containing dark room, clock room, working library, storage and quarters for one or two observers Also two or three separate cottages will be constructed for those members of the staff who will remain permanently on Oak Ridge The architects are Coolidge, Shepley, Bulfinch and Abbott, of Boston.

The new site for the Harvard Observatory has been made imperative by the decision that the northern-hemisphere station should be equipped with a large reflecting telescope comparable to the one almost completed for the southern station in South Africa.

A dozen possible sites have been examined by the Harvard astronomers during the past six months, and the Oak Ridge station was selected as the best in eastern Massachusetts. The land comprises more than thirty acres of woodland, the woods will provide protection against wind, dust and stray light from neighboring villages, farmhouses and highways

Some of the equipment will be in position at Oak Ridge and systematically operated on the regular photographic observing programs before next July. The three patrol cameras, which nightly photograph large sections of the sky to record the positions and brightnesses of the million or more stars that are within their reach, will be part of the Oak Ridge equipment.

It is probable that the 60-inch reflector, which should be ready for installation in fifteen months, and for operation a few months later, will be operated in part by members of the staff living in Cambridge, who will drive to the country for their observing assignments.

Beside the 60-inch reflector, the instruments at Oak Ridge will include the 24-inch reflector and the 16-inch Metcalf doublet, the 16-inch is employed steadily on the photographing of faint variable stars in the Milky Way.

A JUNIOR NOBEL AWARD

The stimulation of research by engineers under thirty years of age is the main purpose of the Alfred Nobel prize granted this year for the first time in honor of the illustrious civil engineer The prize-winning paper, "Arsenic Elimination in the Reverberatory Refining of Native Copper," is the production of Mr Corbin T Eddy, assistant professor of metallurgy at the Michigan College of Mining and Technology, who has conducted most of the first part of that institution's research into the copper-cuprous oxide system, with the ultimate aim of evaluating various methods of eliminating from native copper such impurities as arsenic, silver, iron and oxygen, and of formulating more precisely than has yet been done the effect of each impurity on the physical properties of copper Study of the copper-silver system, the second step of the program, has begun under the general direction of Professor A. T Sweet, department chairman, with Professor Eddy, Professor Drier and Research Engineer Tolonen participating.

The process of copper elimination analyzed in the prize-winning article, which was delivered before the 1931 meeting of the American Institute of Mining and Metallurgical Engineers, was for decades an unregarded method, until revived by Michigan copper men some years ago. It is the method now regularly used by them in the reverberatory refining of native copper.

Papers eligible for the award included all those written by men under thirty years of age which were published in the journals or transactions of the American Institute of Mining and Metallurgical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Western Society of Engineers and other similar organizations. The offering of this junior award is intended to stimulate the increasing production of reports which are both theoretically sound and also valuable to key industries.

SCIENTIFIC NOTES AND NEWS

At the opening meeting of the autumn session of the National Academy of Sciences at Yale University on November 16 the address of welcome will be given by Dr James Rowland Angell, president of the university The response will be made by Dr William Wallace Campbell, president of the academy A public lecture on the evening of November 16 will be given by Dr. John Campbell Merriam, president of the Carnegie Institution of Washington, whose subject will be "The Cats of Rancho La Brea, a Climax to Evolution"

Dr Walter B Cannon, Higginson professor of physiology at Harvard University, on behalf of the faculty of medicine, and Dr Henry Fairfield Osborn, president of the American Museum of Natural History, on behalf of the faculty of science, were awarded the honorary doctorate of the University of Paris at the opening ceremonies held in the Sorbonne on November 7

Dr C. D. Perrine, formerly of the Lick Observatory and for the past twenty years director of the National Observatory of Argentina at Cordoba, has been elected a corresponding member of the Sociedad Cientifica Argentina of Buenos Aires.

Sir Sidney Harmer, lately director of the natural history departments of the British Museum, has been elected a foreign member of the Royal Swedish Academy of Science.

At the inauguration of the new president of Morningside College, Sioux City, Iowa, on October 24, honorary degrees were conferred upon four of its early graduates, including Dr Fred J. Seaver, curator of the New York Botanical Garden, and Dr Alexander G. Ruthven, formerly professor of zoology and director of the museum and now president of the University of Michigan.

Dr. Samuel Newton Spring, professor of silviculture in the department of forestry at Cornell University, has been appointed assistant dean of the New York State College of Forestry at Syracuse University. Professor Spring will assume his duties as assistant dean and director of instruction for both the college and the New York State Ranger School early in 1932.

Dr. Henry Alden Shaw has been appointed assistant professor of mental hygiene at the Harvard University Medical School. He has been associated with the school since 1925 as assistant in hygiene and psychiatrist.

Dr. Marvin L. Pabst, formerly an instructor in the division of pharmacology, College of Medicine, University of Tennessee, has been appointed assistant professor of pharmacology in the University of Buffalo College of Pharmacy.

Dr. Fred O'Flaherty, of the research staff of the University of Cincinnati, has been appointed director of the research laboratory of the Tanners' Council of America

The British Ministry of Agriculture and Fisheries has appointed Mr. J L S Gilmour, curator of the University of Cambridge Herbarium and Museum, of the Botany School, to be assistant director of the Royal Botanic Gardens, Kew

The faculty board of biology at the University of Cambridge has appointed Mr A G Brighton, of Christ's College, curator of the Sedgwick Museum of Geology for three years, dating from October 1

Dr. G H Hardy, Sadleirian professor of pure mathematics in the University of Cambridge, has been elected to a professorial fellowship at Trinity College Dr Cecil Edgar Tilley, professor of mineralogy and petrology, has been elected to a similar fellowship at Emmanuel College

The Soviet Government has granted to Professor Ivan Pavlov an appropriation of 184,000 roubles to complete the building of his biological station at Koltouchi, near Leningrad.

President Hoover has announced the appointment of Colonel Charles A. Lindbergh to be a member of the National Advisory Committee for Aeronautics.

Dr. Percy E Raymond, professor of paleontology at Harvard University, has returned from England, where he was a delegate from the Geological Society of America to the centenary meeting of the British Association for the Advancement of Science.

Dr. Otto Schmidt, German dye chemist and director of the Farbenindustrie Aktiengesellschaft, which is the German chemical trust, has arrived at the California Institute of Technology for a stay of three months, during which he will consult with leading American chemists. Dr. Schmidt will later visit industrial centers

Dr. A. E. Gee, who has spent two years at the University of California Scripps Institution of Oceanography in research on bacteriology, has left for his home in Canada.

Dr. James Ewing, professor of pathology at the Cornell Medical College, delivered the annual discourse at the New York Academy of Medicine on November 5. His subject was "The University and the Medical Profession."

The twenty-eighth Hanna lecture of the Western Reserve University Medical School will be given by Dr. E D Adrian, fellow of Trinity College, Cambridge, and Foulerton research professor of the Royal Society, London Professor Adrian will give an illustrated lecture entitled "The Nervous Mechanism of Sensation and Movement"

Colonel George A Skinner, of the medical corps of the U S Army, gave at the Mayo Institute a Mayo Foundation lecture on October 27 His subject was "Early Experiences in Tropical Medicine"

Dr Carl G Hartman, of the department of embryology of the Carnegie Institution of Washington, showed a movie film on the "Parturition in a Monkey," at the recent meeting of the Central Association of Obstetricians and Gynecologists, before which he also made an address on "Ovulation in Man and Monkey" The film has also been exhibited to the German Medical Society of New York City

The inaugural lecture of the chair of anatomy at the University of Edinburgh was delivered on October 6 by Professor James Couper Brash, who has been elected to the chair of anatomy in succession to Professor Arthur Robinson, retired Professor Sydney Smith, dean of the faculty of medicine, presided

The first public lecture under the Estlin Carpenter Educational Trust was given at Oxford by Sir Peter Chalmers Mitchell on October 13 His subject was "Life and Matter"

Sigma Pi Sigma, honorary physics fraternity, held its convention at the University of Kentucky from November 5 to 7 Dr W F G Swann, director of the Bartol Research Foundation, gave the principal address

The U S Civil Service Commission announces that the position of principal physiological chemist at a beginning salary of from $5,600 to $6,400 a year is open for competitive examination The examination is to fill a vacancy in the bureau of construction and repair, Navy Yard, Washington, D C, and vacancies occurring elsewhere, for duty in Washington, D C, or in the field Applications must be on file with the U. S Civil Service Commission at Washington not later than December 1, 1931.

On October 17 and 18 a group of physiologists were guests at the Morris Biological Farm. They met in response to a resolution passed at a meeting of physiologists and others held on August 12 at the Marine Biological Laboratory, in Woods Hole, to consider the question of organizing a new journal of physiology intended to supplement those already existing and to relieve certain other journals, not devoted primarily to physiological subjects, of papers which take space intended for zoological or anatomical matter Those in attendance were as follows: Dr. E. N Harvey, of Princeton University, Dr. M. H. Jacobs, of the University of Pennsylvania, Dr E K. Marshall, of the Johns Hopkins University; Dr G. H Parker, of Harvard University, Dr A C Redfield, of Harvard University, and Dr H W Smith, of New York University The field to be covered by the journal was fully discussed, and a title and outline of its purposes were tentatively agreed upon. Dr E N Harvey, of Princeton University, was selected as the managing editor, and certain other names were suggested as desirable members of the editorial board

Sixty-five years ago A Léotaud, an eminent ornithologist in Trinidad, completed his collection of birds on that island off the coast of Venezuela, and it was later installed in the Victoria Museum in Port of Spain When this museum burned a few years ago all these specimens were destroyed, including several whose existence since has been doubted because recent collectors had not found similar species. Now, according to an announcement made by the Academy of Natural Sciences, Philadelphia, an expedition, comprising W Wedgwood Bowen, assistant curator of birds in its department of vertebrate zoology, H Radclyffe Roberts, of Villa Nova, and George R Clark, of Cynwyd, has returned from a two-months stay in Trinidad with the most representative collection made since Léotaud's, and containing some of the disputed species, thus verifying his records

The University of Pittsburgh chapter of Sigma Xi announces the following series of public lectures on the culture of prehistoric man November 18, "The Art of Paleolithic and Neolithic Man," by Dr. Andrey Avinoff, director of the Carnegie Museum of Pittsburgh, January 27, "Man, the Speaking Animal," by Dr Melville Jean Herskovits, assistant professor of anthropology at Northwestern University, March 16, "The Origin and Development of Tools and Weapons," by Dr Nels Christian Nelson, curator of prehistoric archeology at the American Museum of Natural History, New York City

The thirty-third annual meeting (the one hundred and seventy-fifth regular meeting) of the American Physical Society will be held in New Orleans at Tulane University, on December 29 and 30, in affiliation with Section B—Physics—of the American Association for the Advancement of Science. The preliminary arrangements for the New Orleans program include joint sessions with the American Mathematical Society on Tuesday morning and afternoon, with addresses by Dr. W F. G. Swann, Professor G. D. Birkhoff and Professor G A. Bliss, including the

Josiah Willard Gibbs lecture by Dr P. W. Bridgman On Wednesday morning there will be a joint session with Section B of the American Association for the Advancement of Science with the address of the retiring vice-president of Section B, Professor F K Richtmyer, and an address by Dr H H Kimball On Wednesday afternoon there will be a joint session with Section E of the association and the Society of Petroleum Geophysicists for a geophysical program

According to an announcement in *Nature* the Ninth International Congress of the History of Medicine will be held at Bucharest, under the presidency of Dr V Gomoiu, next September, when the principal subjects for discussion will be (1) the evolution of medicine in the Balkan States and (2) the protection of Europe against bubonic plague Those wishing to contribute papers on these or other subjects are requested to forward the title and a typed copy of a summary of their paper to the office of the Congress, Str Stirbey Voda 86, Bucharest II, without delay The official languages will be English, French, German, Italian and Spanish Members of the congress can take the direct route to Bucharest or meet at Trieste, whence visits will be paid to Athens, Constantinople and Constantza, where local committees will be arranged for their reception The meetings of the congress will occupy four days, and the following three days will be devoted to a tour of Bucharest and excursions in the neighborhood A program will be issued later, giving the exact date of the congress and the amount of the subscriptions

Nature reports that the twenty-second annual exhibition of electrical, optical and other physical apparatus is to be held by the Physical Society and the Optical Society from January 5 to 7, 1932, at the Imperial College of Science and Technology, South Kensington The trade section will comprise the exhibits of manufacturing firms The research and experimental section will be arranged in two groups. (*a*) exhibits illustrating the results of recent physical research, (*b*) lecture experiments in physics The exhibition committee invites offers, from research laboratories and institutions and from individual research workers, of exhibits suitable for inclusion in either of the above groups Offers of exhibits, giving particulars of space and other facilities required, should be communicated immediately, and in any case not later than November 9, to the secretary of the exhibition committee, 1 Lowther Gardens, Exhibition Road, London, S W 7 The section for apprentices and learners has for its object the encouragement of craftsmanship and draughtsmanship in the scientific instrument trades Apprentices and learners may exhibit, in competition, specimens of their work, providing they are in the regular employ of a firm which is exhibiting at the next annual exhibition, or has exhibited once during the past three years Printed particulars of this section will be sent on application to the secretary

DISCUSSION

CONCERNING AN INCREASE IN THE POTENCY OF MOSAIC VIRUS IN VITRO

In an earlier paper one of us (O)[1] published results of experiments which indicated that multiplication of the virus of tomato and tobacco disease had taken place in the absence of living cells. The work of J Henderson Smith[2] and others cited by him has not been confirmatory of these results, and hence the subject has been studied anew.

About 3,000 tomato plants (with several thousand as controls) were utilized in a series of 30 experiments In 6 of them the original technique was followed as closely as possible In 24 the conditions were altered considerably The hydrogen-ion concentration of the media was kept constant by diluting one part of filtered fresh normal plant juice with 2 5 parts of Northrop's buffer[3] at pH = 5 3, and the tests were made under aerobic or anaerobic conditions, in the dark or sunlight Fifteen experiments were carried out with Gates' U tubes,[4] according to the method of Muckenfuss and Rivers[5] with vaccine virus A collodion sac containing fresh, lightly crushed, young plants in buffer solution was inserted in one arm of the tube and buffer solution containing filtered virus was placed outside the sac. The medium within the sac was replaced from one to seven times weekly The tubes were kept at 28° C

Almost always, irrespective of the method employed, there was some increase in the potency of the virus beyond the original titration An increase has also been noted by McKinney [6] In the early experiments it was much greater than in the later ones, for reasons as yet not clear. There may conceivably be some cyclic variation in the virus The question arises of whether the increase was due to an activation, or a dispersion of aggregated virus particles, by a mechanism as yet not understood, or whether it represented actual multiplication of a living agent. The same problem has arisen in connection with the increase in potency of vaccine virus in a lifeless medium.

---

[1] P. K Olitsky, *J Exp Med*, 41 129, 1925.

[2] J. H. Smith, *Ann. Applied Biol.*, 15 · 155, 1928

[3] J. H. Northrop and P. H de Kruif, *J. Gen. Physiol*, 4: 639, 1922.

[4] F. L Gates, *J Exp. Med.*, 35 635, 1922

[5] R. S. Muckenfuss and T M Rivers, *J. Exp Med.*, 51: 149, 1930

[6] H. H. McKinney, *J Agric. Res.*, 35 · 1, 1927.

In view of the outcome of the experiments, we have concluded that the results of our tests can not with certainty be referred to a true multiplication of the mosaic virus

PETER K OLITSKY
FILIP C FORSBECK

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
NEW YORK, N Y

GEOMORPHOLOGICAL EVIDENCE OF A CLIMATIC BOUNDARY

ONE of the most significant climatic boundaries across the United States separates the territory experiencing effective winter cold from warmer regions on the south Within humid climates the northern region is often called the cool temperate and the southern, warm temperate climate In the terminology of the Koppen[1] system of climatology the two are designated microthermal and mesothermal, respectively Within the realm of the dry climates the distinction becomes that between hot and cold steppes and deserts

In a recent paper the writer[2] has presented arguments in favor of using one and the same boundary whether climates are humid or arid and has suggested that in the United States the January isotherm of 32° F appears more satisfactory than any other proposal thus far made[3] Certain contrasts were pointed out in vegetational, soil, geomorphological and cultural forms on the two sides of that isotherm. Since the publication of that paper he has observed a very interesting and fundamental condition that lends additional support in favor of the January 32° F thesis.

The January isotherm of 32° F enters the Atlantic Seaboard approximately at New York City, swings southward through New Jersey and across the Appalachian region, west of which it approximates the positions of the Ohio and Missouri rivers as far as the eastern boundary of the dry climates

In the Trenton Folio of the United States Geological Survey Florence Bascom[4] calls attention to the fact that in the Coastal Plain of New Jersey topography sloping toward the north is notably steeper than that toward the south The writer is not only able to confirm this observation but finds that it applies with equal force in landscapes of southern Ohio South of both of these regions it disappears, thus appearing to be related to the position of the January 32° F. isotherm both east and west of the Appalachians

In both cases the nature of the underlying bedrock is such that it could not possibly account for the observed slope asymmetry, as it is very nearly flat-lying. It is obvious that the details of sculpture must be ascribed to denudational processes now taking place.

While contrasted angles of incidence of sunlight on north and south slopes condition processes of weathering, evaporation rates, vegetational cover, and other denudational elements, it seems apparent that the greatest single effect is with reference to snow cover On the borderlands of the region effectively blanketed by snow for considerable periods during the winter months, slight differences in slope direction produce enormous contrasts in the length of time snow actually remains on the ground. The relatively sunny southward slopes are barren for long periods during which northward slopes lie beneath thin sheets of snow. The snow protects the ground beneath from denudation during much of the critical winter period. Thus a contrast arises in the rate at which denudation takes place on the banks of any rills or streams flowing in directions approaching east or west The northern bank, being the more rapidly attacked, has its gradient lessened in comparison to the southern bank, hence arises the topographic contrasts observed.

It is notable that in the southeastern United States erosion and denudation take place very rapidly, particularly as the result of the absence of frozen soil or snow cover during the winter season of vegetational dormancy, whereas in the northeastern and north central regions these processes are comparatively slow. Agricultural occupation aggravates conditions to such an extent that the loss of soil from the fields of the southern states has become recognized as a major national problem, and one recently receiving much attention as a result of the studies of H. H. Bennett and others. From the standpoint of climatology the contrasted regions may be considered mesothermal and microthermal climates.

Recognizing that all climatic boundaries are attempts to indicate mean positions within zones of gradual change, the asymmetrical slopes of New Jersey and southern Ohio have unusual interest in respect to the climatic boundary under consideration. The snow-covered northward slopes are effectively microthermal as regards snow cover and the southward slopes are mesothermal Thus, from the geomorphological standpoint, in the vicinity of the isotherm of January 32° F., we find an ideal expression of climatic borderline conditions, innumerable islands of one climate within the realm of another Whereas climatic contrasts may take place within comparatively short distances in areas of considerable relief, it is unusual to find them so strikingly displayed in such comparatively flat regions as those under discussion and hence of all the greater significance

---

[1] W Köppen, "Die Klimate der Erde" (Berlin, W de Gruyter Co, 1923)

[2] R. J Russell, "Dry Climates of the United States· I, Climatic Map," *Univ Calif Publ Geog*, 5 1–41, 1931

[3] W Köppen (1923) uses the mean annual isotherm of 18° C (64 4° F) in dry climates and the January isotherm of –3° C (26 6° F) in humid climates. On the more recent Köppen-Geiger "Klimakarte der Erde" (1. 20,000,000), (Gotha, Justus Perthes, 1928), he uses the value of eight or more months above 1° C (33 8° F) in humid climates Van Royen, *Monthly Weather Review*, 55 319 (1927) suggests, for the dry climates, the cold month isotherm of 50° F.

[4] Folio 167. 2, (1909).

RICHARD JOEL RUSSELL
LOUISIANA STATE UNIVERSITY

CHLORATES AS HERBICIDES

THE persistent spread of the more noxious perennial weeds has recently focused the attention of many experimental workers on the problem of a cheap, safe and effective chemical method for the eradication of these plants Sodium chlorate has proved in many trials to be the most generally effective herbicide now in use With proper methods, such weeds as Canada thistle (*Cirsium arvense*), European bindweed (*Convolvulus arvensis*), quack grass (*Agropyron repens*) and similar plants can be controlled with one or more applications of this chemical. The cost ranges from twenty-five to one hundred dollars an acre and the fire hazard may be very serious with the usual methods of application in which a chlorate spray is applied to a heavy growth of foliage.

A three-year study of the herbicidal action of sodium chlorate in the botany department of the Iowa State College indicates that this compound may be more effective when applied to the roots rather than to the aerial portions of the plant, and suggests that under humid conditions the elimination of perennial plants by spraying with chlorates is dependent upon a portion of the spray residue reaching the soil. By applying the chemical, either crystalline or in solution, directly to the moist soil it is possible to reduce the quantities applied, and if the top growth of the plants is removed before treating, the principal fire hazard is eliminated. The apparently unchanged chlorate salt persists in the soil for a period varying with the conditions from a few weeks to two or more years. The herbicidal action consists of both a direct killing of the underground portions of the plants and of translocation to and slow killing of any new sprouts which may be formed. The importance of the two effects probably varies with the plant and the conditions. Quack grass or Canada thistle rhizomes and roots may be killed in the dormant stage, so that the effects of ultra-violet light are not required for the toxic action of chlorates. We have been unable to obtain any appreciable translocation of the toxin except in the transpiration stream, and any generalized action seems to be dependent upon the ability of the salt to persist in the soil solution, where, as stated, it may either penetrate and kill the roots and rhizomes, or be absorbed and translocated to transpiring regions of the top. The continued killing of the tops adds starvation to the direct action on the underground organs and explains the effectiveness of the treatment

The tendency of the chlorate to persist in the soil may become seriously objectionable under some conditions. In our field tests we find that heavy applications which result in a large quantity of the salt reaching the sub-soil are particularly persistent. Temperature and leaching seem to be the most important factors concerned in the disappearance of chlorates At temperatures of 25 to 30° C treated soil loses its toxic properties in a few weeks, while in the sub-soils mentioned (three to five feet) the chlorate concentration is still too high to permit crop growth nearly two years after the initial application. The surface foot of these same plots which received chlorate at the rate of 1,000 pounds per acre is normal. The use of lighter applications under more favorable conditions should reduce the deep penetration and persistence of chlorates.

The recognition of the fact that chlorates are effective when used as root absorption poisons will permit the use of the sodium salt instead of the more expensive calcium chlorate It will make it possible to eliminate the fire danger, now a very serious factor, avoid the destruction of chlorates exposed on the leaves of sprayed plants and help to reduce the aftereffects of chlorate applications by avoiding excessive applications in cool soils not subject to leaching.

W E LOOMIS
RUSSELL BISSEY
E. V. SMITH
DEPARTMENT OF BOTANY,
IOWA STATE COLLEGE

THE CAUSATIVE ORGANISM OF A PAPULAR TYPE OF APPLE MEASLES[1]

THE disease known as apple measles, reported first by Hewitt and Truax[2] in 1912 as an obscure apple disease, has recently attracted especial attention in certain sections. This disease has been reported under various names which include "measles," "pimple canker," and "scurfy canker." Previous investigators have considered it to be of a non-parasitic nature and of minor importance. It has been stated that it does not cause the death of the trees affected. This opinion, however, has been considerably modified as a result of recent investigations. The writer's studies seem to indicate that the various forms of measles hitherto described are not all manifestations of the same causative agent but are distinct diseases. One of these types of measles, a papular form, briefly reported here, has been proven to be caused by a parasitic fungus.

---

[1] Approved by the director of the West Virginia Agricultural Experiment Station, as Scientific Paper No. 97.

[2] J. L. Hewitt and H E. Truax, ''An Unknown Apple Tree Disease,'' Arkansas Agric. Exp. Sta. Bull. 112; 481–491, 14 figs, 1912.

The disease first came to the attention of the writer in 1915, in the course of the application of an orchard dusting program in the Kanawha Valley, north of Charleston, West Virginia. Measles at that time was confined to a few Red Astrachan trees. The trunks and larger limbs presented a peculiar scurfy appearance while the younger twigs, especially the water sprouts, were covered with small, well-defined papules. Attempts to isolate an organism from these papules always resulted in sterile plates. Subsequent attempts in later years yielded the same results.

Frequent visits to this orchard each season, since the disease was first observed, have enabled the writer to observe its spread from the Astrachans, which constitute only a very small percentage of the planting, to Rome, the predominating variety. Interplantings of Gano, Transparent, Chenango, Pound Royal and Summer Queen, remained free from measles. Two years ago the orchard was abandoned because the disease had practically killed 16,000 trees. In the meantime numerous specimens of apple twigs affected with this type of measles have been obtained from adjoining counties in central and southern West Virginia.

In 1929, an active study of the disease was undertaken at this station. The work was conducted in the Kanawha orchard, where the papular type of measles was most prevalent. Small Red Astrachan and Stark's Delicious trees were planted near large Red Astrachan trees infected with measles. Both varieties became heavily infected with the papular form the first season. Attempts to isolate the causal organism again ended in failure. In 1930, the writer was stationed in the orchard throughout the growing season in order to keep the development of the disease under close and constant observation. However, due to the unprecedented drought very little infection took place. A few rains occurred late in the summer and a total of only 44 papules of new infection were located in the entire orchard, all on Red Astrachan, which seems to be the variety most susceptible to this form of measles. *Thirty-four of these yielded pure cultures of a peculiar, slow-growing fungus.* Sporulation of this fungus can be obtained by growing it on oatmeal or malt-extract agar.

Successful artificial inoculations were obtained on young Red Astrachan trees in the greenhouse during the past winter and the fungus was readily reisolated from the lesions produced. Diseased apple twigs collected in the Kanawha orchard on June 20, 1931, were placed in a moist chamber for 24 hours. Spores were obtained by scraping the surface of the older lesions. By studying free-hand sections of the diseased spots it was found that the fungus is a *Hyphomycete* and apparently belongs to the genus *Clasterosporium*, the species being yet undetermined.

ANTHONY BERG

WEST VIRGINIA UNIVERSITY,
MORGANTOWN, WEST VIRGINIA

BIOLOGICAL ABSTRACTS—A DISCUSSION

THE value of such a comprehensive abstracting system as Biological Abstracts is well recognized by all workers in biological sciences, and is very well summarized in several articles published recently in SCIENCE.[1] In spite of the value of such a journal to subscribers, there are certain admitted drawbacks to it among which are the delay in publication, the cost of such an undertaking, and the time consumed by 6,000 abstractors and one hundred or more editors. If this were a temporary matter we might all be willing to help by personal effort or subscription, but it is a perpetual matter and as already shown will demand more time, effort and money as the years go by. It would therefore appear worthwhile to see if some method could not be devised to simplify this enormous undertaking.

As I understand the present system used by Biological Abstracts, an editorial and clerical staff first reviews the entire biological literature of 55,000 articles (yearly), and then decides who should abstract each of these articles (55,000 decisions). The well-known yellow abstract requests must then be mailed, asking for abstracts (55,000 letters). Many of these need second requests, inquiries, change of abstractor, etc. After this 6,000 men and women abstract these 55,000 articles which if done conscientiously is a difficult and tedious matter, many of us have seen young men struggling over an article in a foreign language which they very imperfectly understand. After these abstracts are made they are mailed to Biological Abstracts, who then collect, and remail to section editors, who in turn edit these collected abstracts in their field and return to Biological Abstracts where they are finally printed. Such a procedure is obviously complicated, expensive, time consuming and needs besides the voluntary support of some 7,000 men yearly, an additional aid at present of more than $100,000, all of which will have to be increased in the future. Considering that Biological Abstracts is not a personal undertaking, but a program of interest to all biologists let us see whether there is any other *practical alternative to the present method*

---

[1] W. C. Curtis, SCIENCE 73: 1898, 509, 1931; J. R. Schramm, SCIENCE 73: 1898, 512, 1931; C. E. McClung, SCIENCE 73: 1898, 517, 1931; F. R. Lillie, SCIENCE 73: 1899, 560, 1931.

Let us consider a plan of obtaining the cooperation of all editors of biological journals in requiring that an abstract of each article be submitted by the author with the original manuscript (as is already the case in certain journals) Assuming for a moment that such a plan could be put in force, every article of biological nature would be abstracted even before publication When an editor had a number of his journal made up, these abstracts could be simply mailed to Biological Abstracts and published at once In this way there would be no delay in the appearance of abstracts Authors would receive immediate recognition of their work Investigators could obtain an immediate review of all biological literature, and several thousand voluntary abstractors and section editors would be relieved of their constant nonremunerative drudgery The paid editorial and clerical staff as well as general expenses could be greatly reduced

The first and almost unanimous comment obtained regarding such a plan from those whom I have consulted during the past four or five years is that "*It will not work*" *This has however been said of many* successful undertakings The advantages of such a plan are obvious, and have been granted by numerous abstractors, section editors, editors of biological journals, and several of the best librarians of the country Let us consider the possibilities of carrying out such a plan and some of the criticisms which have been raised

(1) It is said that the editors of biological journals could not or would not obtain these author abstracts It is probable that only a small percentage of these editors would agree to such a plan at first, but if the plan were supported by an influential group of editors, and their acceptance of it brought to the attention of others, many more would fall in line

(2) The comment has been made that authors would not submit abstracts This could be very simply taken care of by editors refusing to publish manuscripts not accompanied by abstracts

(3) Another criticism is that authors are often unable to abstract clearly and concisely This may equally well be said of voluntary abstractors What is wanted in an abstract is the main points of the work stated correctly, not a critical review Certainly authors should be able to do this more intelligently than anyone else

Finally let us consider practical ways in which such a plan might be carried out Obviously the editors of Biological Abstracts do not wish to be burdened with further projects The success of such a plan as *outlined, lies with the editors of the various biological* journals It is felt that the most likely way to interest them in adopting such a method would be for all authors, abstractors, section editors, etc, to write to the editors of those journals in which they are particularly interested, expressing their opinion of such a plan Biological Abstracts could be helped directly by any editor guaranteeing them abstracts of his journal If a few editors should adopt the system others might fall in line and gradually such a plan might be universally adopted The author would be glad to receive any comments on this proposed plan or word from any editor putting such a plan in force in his journal, and to report at a later day any progress made

Paul D Lamson
Department of Pharmacology,
Vanderbilt University School
of Medicine,
Nashville, Tennessee

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ADAPTATION OF THE BOX CAMERA TO PHOTOMICROGRAPHY

A box camera can be converted into a photomicrographic camera suitable for general routine work with a few minor changes The camera used should be of metal construction and must have a removable front Any of the Eastman Kodak Brownie cameras will serve the purpose though the larger models are to be preferred.

The first adjustment is to remove the front of the camera and enlarge the central aperture therein. Pry off the ferrule from about the hole and enlarge the hole with a round file until it will just admit the threaded portion of the eye lens of an ocular Insert the eye lens into the hole from the inside surface of the front plate and screw the ocular tube in place, thus enclosing the camera front between the eye lens and tube of the ocular Next remove the lens and shutter block from the camera, take out the lens and return the block to its former position.

To make the focusing apparatus, a tube of brass or stout cardboard between ⅝" and ⅞" in diameter is cut to a length ascertained as follows, remove the back of the camera and cut a piece of glass just large enough to rest upon the rollers that support the film and upon nothing else Mark an X with a wax pencil in the center of this glass sheet and bring a tripod magnifier (Bausch and Lomb 7.5X or other suitable lens) to focus through the glass on the X (Be sure you focus through the glass) Now place the glass sheet and the magnifier upon the camera with the X towards the inside of the camera, insert the ocular with its attached camera front into the microscope, place the camera upon its front on the microscope and measure the distance from the upper surface of the metal mount of the ocular eye lens to the X on the under surface of the glass and from the under surface of the glass to the under surface of the lens of the magnifier Cut the tube in length corresponding to the sum of these two dimensions

In using the camera it is loaded with film in the usual manner, the front plate is attached to a suitable ocular, the ocular placed in the microscope and the focusing tube placed upon the upper surface of the ocular The tube is then surmounted by the same magnifier as previously used and the image is brought to focus through this assembly When the focus is as sharp as possible remove the tube and magnifier and carefully place the camera over the ocular and upon its front Turn off the light source or place a cardboard between it and the microscope, set the shutter for time and open it, turn on the light for the required length of time, turn off the light, close the shutter

One warning is here necessary Be very sure that the coarse adjustment of the microscope is tight enough to support the camera without putting the image out of focus.

Though the modern roll film box camera is here used as an example there is no reason why some of the older model plate and film pack boxes or some of the newer foreign film pack boxes can not be suitably converted into photomicrographic cameras. The advantages of plates and film packs in photomicrography is unquestionable

Finally, any photomicrographic camera, in order to record the image at the same magnification that the eye sees it, must afford at least ten inches of space between the ocular and the plate or film Since the box camera is much shorter than ten inches due allowance must be made in the magnification of the microscope in order to obtain the desired results

Charles S Apgar

Wistar Institute of Anatomy

A METHOD FOR THE PRESERVATION OF OLD MANUSCRIPTS

An entirely satisfactory method of preserving old manuscripts does not appear to be known Particularly desirable is one for preserving old letters and similar material, which can be cheaply and readily prepared and which can be used by any one with fair manual dexterity, but without requiring special expert knowledge of physics, chemistry or paper technology The method here discussed has been tested with gratifying results.

Procedure

A mixture of equal volumes of carbon tetrachloride and benzene is prepared and kept in a tightly stoppered bottle The mixture is not explosive, but benzene vapor is, so reasonable precautions should be observed. As this mixture is an excellent solvent for fats, care should be taken to keep from contact with the worker's skin and to anoint the place of any contact with the person with olive oil, cold cream or some fatty ointment

To 100 cubic centimeters of the solvent mixture is added 30 to 35 grams of a good hard wax. This solution is equivalent to one of a pint of the mixed solvent to five or six ounces of wax In our experiment good results were obtained with the commercial product known as halowax number 1,013, with a melting point of 248° F Oven tests of news print and other papers treated with this wax showed it would not run or stick at any summer temperature imaginable.

Most conveniently the wax is applied by pouring the solution into a shallow pan or dish, such as a photographer's developing trap. The paper is immersed, care exercised that it be completely wetted and any bubbles formed on either side be removed. The paper is then drained by holding it vertically and turning from time to time to prevent undue deposit of wax at an edge

An alternative method is to apply the wax solution to the paper with the camel's-hair brush But the immersion procedure has been found more desirable.

When drainage ceases, the treated paper is dried. Oven drying is practicable but air drying seems preferable. To this end the treated paper is laid upon a smooth surface on blotting paper (when practicable) and exposed until the odor of neither benzene nor carbon tetrachloride can be detected longer. When dry, if too much wax appears in places on the surface of the paper it may be smoothed over with the camel's-hair brush moistened with the solvent.

Discussion

Manuscripts so treated are protected from atmospheric action The paper always seems to be strengthened and very fragile pieces become susceptible of safe handling if careful. Breaks in the wax film, due to bending or impact for instance, can be readily replaced by brushing with the dissolved wax or with the solvent.

The softer waxes generally impart a yellowish or brownish color, are prone to stick but are more pliable and being amorphous give a better protection from attack by air or moisture The harder waxes, such as the above noted, impart no color, do not stick even under considerable pressure and rather high temperatures. They are more apt to yield cracks or breaks under rough handling. On standing, as can be observed under a microscope, the whole film tends to crystallize into a matter mass. It is reasonable to infer that such a film can not give as good protection from the atmospheric attacks as the softer films. Perhaps a satisfactory compromise may be obtained by mixing two or more waxes Our experiments, however, favor the use of a hard wax as stated

Due to the rapid evaporation of the carbon tetra chloride and benzene, the solutions become more concentrated when allowed to stand in the air For this reason the solution should never be allowed to stand in the open except when being used. If the solution becomes too concentrated more of the carbon tetrachloride-benzene mixture should be added If a hydrometer is at hand, it is a good idea to take the specific gravity of the solution at the beginning and on evaporation of the solvent more of it should be added to bring the specific gravity down to that of the initial solution

If previous cleaning of the manuscripts is desirable, the procedure described by J. C. Fitzpatrick is suggested[1] After waxing the manuscript can be conveniently cleaned or washed, although care should be exercised to carefully remove any excess water, especially when hard wax has been used.

No ink has yet been encountered which dissolves or "runs" in the wax or the solution, and the dried film produces no appreciable diminution of legibility

The fire hazard is generally decreased by the wax Treatment with insecticides, fungicides or even rodent repellents is not made more difficult. In fact, the use of some of these may be facilitated by dissolving them in the wax solvent.

Further work with protecting films is in progress The easy application and apparently great usefulness of the procedure described impels us to call it to immediate notice of interested parties.

The halowax used was obtained from Halowax Corporation, 247 Park Avenue, New York City

J. P. SANDERS
F. K CAMERON

CHAPEL HILL, N C.

---

[1] "Notes on the Care, Cataloging, Calendaring, and Arranging of Manuscripts," 3rd Edition, U. S. Government Printing Office, 1928.

THE USE OF LIVE NEMAS (METONCHOLAIMUS PRISTIURUS) IN ZOOLOGICAL COURSES IN SCHOOLS AND COLLEGES

ANSWERING very numerous requests for a free-living nema suitable for school and college class work, attention is called to *Metoncholaimus pristiurus*, a slender, five-millimeter species common in European and North American stagnant marine mud, below low tide—for example, in the harbors at Woods Hole, Massachusetts, and Naples, Italy—a nema suitable for study alive with moderate and high powers of the microscope It is a well-differentiated, bisexual nema that can be sent by post or express long distances in a living condition, and there seems no reason why the usual collecting agencies should not supply it alive to any inland laboratory at moderate cost It withstands journeys of thousands of miles, *e g*, it has been successfully shipped (both summer and winter) from Woods Hole, Mass, to Washington, D C; Durham, N C; and Salt Lake City, Utah, and successfully used in class work One laboratory director reports a "very interesting and exciting two-hour period."

This nema may be ordered from the Supply Department of the Marine Biological Laboratory at Woods Hole, Massachusetts, and no doubt could be supplied from Naples, and many other harbors Laboratory instructors will find readiest guidance to the anatomy, etc, of this and very similar nemas in *Jour. Washington Acad Sci*, vol 20, No 12, 1930. Experienced nematologists consider free-living marine nemas the best teaching material for entrance to nematology *Metoncholaimus pristiurus* belongs to a large marine group, the *Oncholaiminae*—type genus *Oncholaimus*,—abundant in all oceans, and hence may perhaps be considered as nearly "a representative species" as one is likely to obtain from such an immense and varied phylum.

(1) *Collecting* *Metoncholaimus pristiurus* may be successfully dredged with a metallic, one to two-liter cylindrical vessel, one to two decimeters in diameter and two to three kilograms in weight, cast several yards from shore, allowed to sink to the bottom, and slowly pulled in by means of 25 meters of ⅜ inch limber rope, firmly linked at a single point on its rim. This dredge, cheaply made from iron pipe, should sink through any bottom growth of eel-grass, etc., so as afterward to bite into the top layer of mud in which the oncholaims live.

M. pristiurus is about the largest nema in its native mud, and hence is readily assembled for shipment, with the aid of appropriate sieves (1st, 1/8 inch mesh to remove coarse débris; 2nd, 1/24 inch mesh to catch the nemas while permitting silt to pass through). Preferably the nemas should defecate in clean, cool sea water for a day or two before examination, since at the time of collection they may contain considerable ingested mud that would interfere somewhat with the microscopic examination—although the nemas can be profitably examined immediately on collecting.

It is very important to the student of nemas that he *study living material*. For examination alive, *M. pristiurus* may be placed in a drop of tap water for from 10 to 60 seconds until it quiets down, and then mounted at once in a droplet of clear sea water under a thin cover-glass with sufficient pressure to keep the nema from moving more than a very little. This pressure can be applied by drawing the extra sea water from under the round cover-glass with a sliver of filter-paper until the nema can barely move, and then sealing in at once on a turntable with a modicum of smoking hot wax (formula, 1 of beeswax plus 3 of 45° paraffin), best applied from the wick of an ignited, narrow 5-millimeter-gauge taper made of the wax, somewhat like a Christmas-tree candle,—but boiling hot wax and a No. 2 water color brush will answer. A small amount of movement of the nema during microscopic examination is very desirable because the various nemic organs reveal their contours more readily when sliding slightly one on another. Mounting direct into 5 per cent KOH solution displays various cuticularized organs—mouth parts, spicula, etc., more distinctly.

(2) *Advantages.* There are many marine nemas obtainable at seaside stations more suitable for class use than *M. pristiurus,* but none of them is yet known to bear transportation so well. The drawbacks of *Metoncholaimus pristiurus* are: (1) Its amphids (very important characteristic organs, universal in nemas) though well developed, are rather difficult to see, (2) the sensory setae so prevalent on aquatic nemas are here not very well developed, (3) there are no eyespots, (4) the tissues are not quite as transparent, and hence not quite as readily studied, as in some other forms.

Its advantages are: (1) It is relatively large, and is available at any season, (2) it can be shipped long distances alive, and be kept alive for weeks in cool laboratory storage; (3) it presents the demanian system of organs—indicative of the fact that nemas possess whole systems of organs as yet comparatively unexplored, (4) it presents all the numerous advantages which well-developed free-living forms possess over the parasitic forms commonly used as teaching material, such as, among other things, (a) distinctly developed mouth parts, and salivary glands, (b) caudal glands and spinneret, (c) well-developed amphids, (d) sensory setae, (e) readily visible central nervous system, parts of the peripheral system being easily demonstrable by using sea water-methylene blue (over night), (f) a more or less visible renette, (g) well-developed longitudinal cords and associated organs, (h) visibly differentiated intestinal cells (among them the "birefringent" cells), (i) a double gonadic system in the male, *the primitive and normal condition* (although, here, as it happens, single in the female and thus atypical), (j) growth, fertilization, etc., of the living ova can be observed *in situ,*—all these more or less readily observable without dissection.

(3) *Shipping.* It is recommended that in transportation for laboratory use *M. pristiurus* be shipped with half a liter or so of sea water in a separate container, since additional pure sea water is necessary as a mounting medium for the living nema, and permits renewal during lengthy laboratory storage of the sea water containing the nemas, also, that it be put into the mail or express immediately before closing time, that it be packed with ice or solid insulated CO_2 so as to remain cool in transit, and that it be shipped under cool conditions. The nema is so small that hundreds can be packed in the small space suitable to air mail, and this method of shipping is very desirable, especially as air mail temperatures are not likely to be excessively warm. These nemas stand freezing temperatures.

N. A. Cobb

Bureau of Plant Industry,
Washington, D. C.

SPECIAL ARTICLES

A CHART OF RADIOACTIVE ELEMENTS INDICATING THEIR STRUCTURE

The terminology and some of the data of this chart are based upon the recent report of the International Radium-Standards Commission.[1] The purpose of the chart is to indicate the structure of the nucleus as well as that of the electron shell of all radioactive isotopes.

The lower part contains the familiar disintegration series: double circles for the uranium-radium family; single circles for the uranium-actinium family, and squares for the thorium family. The position of AcU and UY is doubtful and indicated by the broken circle. The average life of the atomic species is indicated by bold type—those having a period of over one year, Roman characters—those from one hour to one year, and italics—those existing less than one hour.

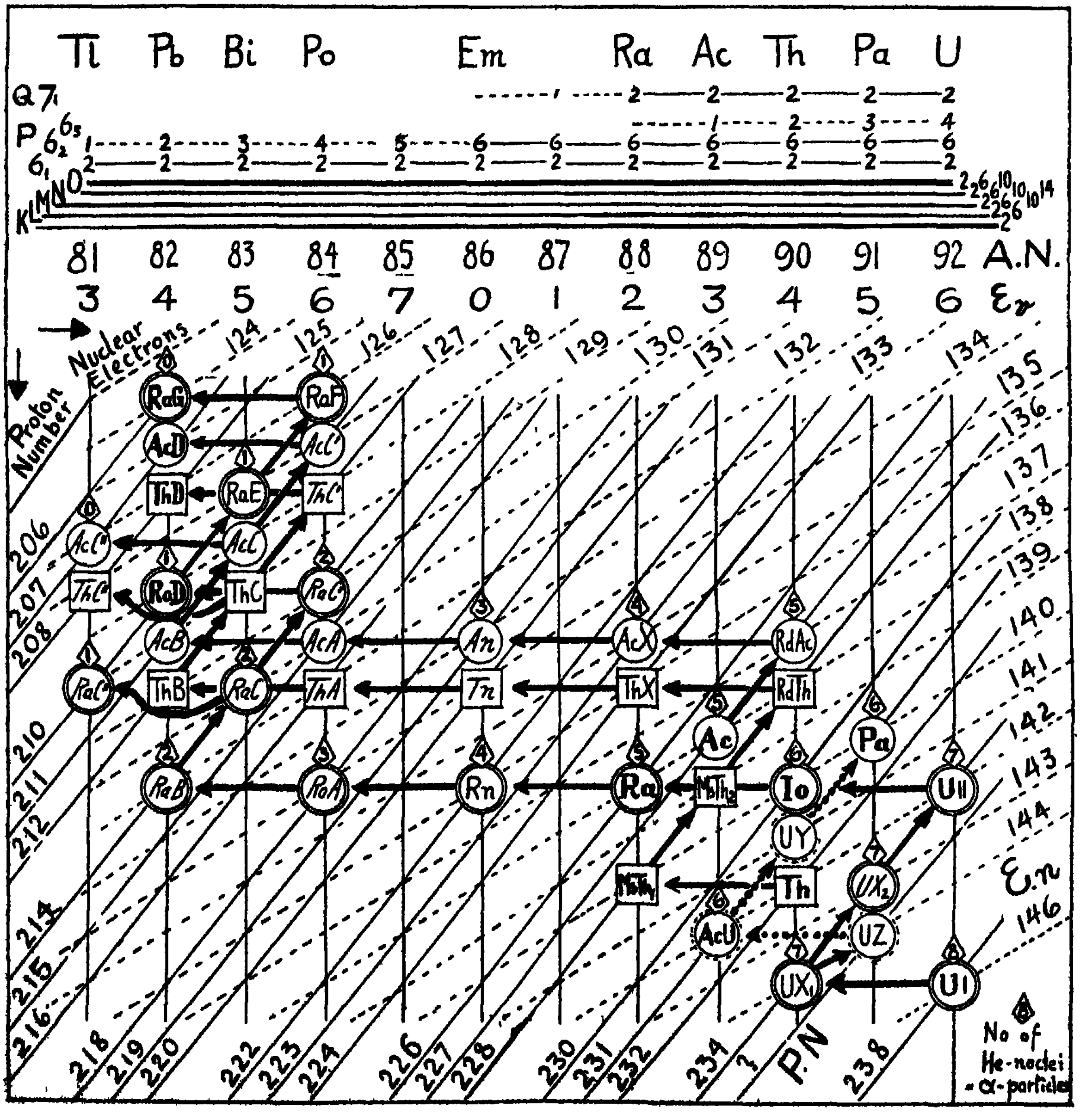
Nuclear structure is indicated by the number of protons and electrons. The proton number, or isotopic weight, is shown on the left and lower edge, they occur in groups of three with some numbers missing. The number of nuclear electrons connects the isotopes at a different angle and it is interesting to note that there are in no instance more than three atomic species for a given number of nuclear electrons and each of these belongs to a different family Thus 126 nuclear electrons occur in RaF, ThD, and AcC″, while 140 electrons are found in Pa, Io, MsTh$_1$ The table records all atomic species thus far known to exist between P N 206 and E$_n$ 124 to P N 238 and E$_n$ 146 The small number in the trapezium indicates the number of helium particles which the atomic species can lose. If Pb^{206} = RaG = x, Pb^{207} = AcD = y and Pb^{208} = ThD = z, then it follows that RaF = He x, AcC = He y and ThC′ = He z and Rn = He$_4$ x, AcX = He$_4$ y and ThX = He$_4$ z and so on to UI = He$_8$ x Alpha-rays are shown by the arrows pointing to the left, beta-rays by those pointing upwards

---

[1] Curie, Debierne, Eve, Geiger, Hahn, Lind, St. Meyer, Rutherford and Schweidler, *J. Am. Chem. Soc.*, vol. 53, p. 2437, July, 1931.

The quantum numbers for the normal state are in the upper half of the table, the continuous lines indicate that the K, L, M, N, and O shells are filled, while the broken lines indicate the energy layers which are being filled up, that is the P and Q shells The atomic number, A N, and normal valence electrons, E$_v$, complete this portion of the chart

A study of the chart reveals that in beta decay the nucleus not only loses an electron, but also the valence


Tl Pb Bi Po Em Ra Ac Th Pa U
Q 7$_1$
P 6$_3$ 6$_2$ 6$_1$
K L M N O
81 82 83 84 85 86 87 88 89 90 91 92 A.N.
3 4 5 6 7 0 1 2 3 4 5 6 E$_v$
Nuclear Electrons
124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 146
E$_n$
Proton Number
206 207 208 210 211 212 214 215 216 218 219 220 222 223 224 226 227 228 230 231 232 234 238
P.N.
RaG RaF AcD AcC′ ThD RaE ThC′ AcC″ AcC ThC″ RaD ThC RaC′ AcB AcA An AcX RdAc RaC″ ThB RaC ThA Tn ThX RdTh Ac Pa RaB RaA Rn Ra MsTh$_2$ Io UII UY MsTh$_1$ Th UX$_2$ AcU UZ UX$_1$ UI
No of He-nuclei = α-particles

shell gains an electron, while in alpha decay, both nucleus and valence shell lose a pair of electrons each [3]

INGO W. D HACKH
COLLEGE OF PHYSICIANS AND SURGEONS,
SAN FRANCISCO, CALIFORNIA

THE SUGAR TOLERANCE OF YEASTS EXPRESSED IN ATMOSPHERES

MYCOLOGISTS who study microorganisms on culture media are presented with physiological problems, such as the osmotic relations of microorganisms to their substrata The plant physiologist considers and observes such relations in single cells and in turn in groups of cells The microbiologist studying yeasts has a good opportunity to appreciate the interplay of osmotic forces outside and inside cell membranes, because of the advantageous size of these organisms

In considering the osmotic relations of any cell or group of cells we get a true picture of natural conditions, if we think of each cell, tissue or organism as part of a moist system We think then of the substratum and the yeast cell, for example, as in a continuous relation through moisture or water Such continuity of water relations is absolutely essential for all organic life We are apt, however, to think of a fungous body as merely displacing a volume of the solution in which it occurs If we regard this displacement as anything but the occurrence of an instant we do not have a true picture We had best think first of the continuity of the moist environment of the microorganisms as being throughout their cell structure

The environment in which we culture our microorganisms is generally of the density or water content presented by dextrose broth or agar, which is in turn theoretically influenced by the moisture content of the air in the test-tube Microorganisms growing on agar slants absorb or give off solutes only and therefore are most intimately related to organic substances which became solutes in a moist environment There is no exchange between the protoplasm of a cell and its environment except as substances in solution

For a further realization of this principle, picture yeasts or molds in juxtaposition to grains or particles which are of such a nature as to be unchanged by any reaction Picture these yeast cells and such inert particles as part of a moist system. The moist environment is continuous throughout the yeast cell. The inert particle is unaffected There is no interplay of osmosis between the living cell and the inert grain. Replace the particle with a sugar crystal of the purest type. The moist environment is now continuous with the crystal as well as with the living cell. There can no longer be the inert relation which existed between the yeast cell and the inert particle. The living cell, the syrup films of the crystal and the crystal must adjust their osmotic relations, and this continually Life is not an equilibrium, but is continually trying to approach it. It is always getting there When we admit these conceptions, we must admit that all microorganisms which carry on metabolic and reproductive activities in concentrated solutions have a higher tolerance of high osmotic pressures than those subsisting only in dextrose broth of the standard methods or in the liquid phase of a solid culture medium

What specific proofs are there of such a relation pertaining to yeasts tolerant of concentrated sugar solutions? The following instances are illustrative and sufficiently indicative When we use water blanks instead of a sugar solution for dilution blanks in count work, with sugars the count is lower, because some cells are killed by the dilution water We may also observe the same relationship when we take a loop of growing yeasts from a sugar solution of 50 per cent. total solids and add to it water or more dilute sugar solution to complete a microscopic mount. Again almost instantaneous plasmolysis occurs, when we mount living yeast cells growing on a sugar agar slant of 50 parts of sugar to 100 parts of agar medium in water or broth containing 35 parts of sugar per hundred. Further, yeasts grown at as high a concentration as 50 parts of sugar to 100 of broth or agar medium are smaller than when grown in 35 parts of sugar to 100 parts of broth or agar medium Pfeffer[1] claims that as cells become acclimated to concentrated solutions the cell wall develops strength and the radius of the cell decreases as the cell's resistance to osmotic pressure increases. Cells thus accommodating themselves to concentrated nutrient solutions which constitute their environment must be inherently able to increase the amount of osmotic substance they contain With such accommodation the appearance of the protoplasm changes. We have observed excessive vacuolation in yeasts growing in high sugar solutions.

The density of sugar solutions may be expressed as atmospheres Considering the usual broth media, we find that from 1½ to 3 per cent. of sugar is their usual concentration. A 1 per cent. dextrose solution would have its osmotic pressure expressed in atmospheres by a value of 1.25. Dextrose broth containing 1 per cent. of sugar would be somewhat higher, due to added nutrient, as beef extract or peptone. The inoculated medium, due to the inclusion of the [illegible] ple, would be somewhat higher in value expressed as atmospheres. Plant cells when turgescent have a cell sap represented by 5 to 10 atmospheres. Beet sugar sap has a value of 15 to 21 atmospheres, or that of a 25 to 30 per cent. solution of sucrose Fungi as Penicillia and Aspergilli have been grown in concentrated solutions having a value of 157 to 160 atmospheres, or an equivalent of 45 per cent KNO_3.[2] Owen[3] in Louisiana was able to grow yeasts in molasses having a density of 70 per cent. total solids or when figured as sucrose the equivalent of 225 to 260 atmospheres. As molasses contains lower sugars and gums the figure is actually higher We have grown yeasts in culture tubes where the medium was 62 per cent. total solids, which may be represented by 140 to 180 atmospheres figured as sucrose The actual figure is higher for the reason stated above. Also we have grown yeasts in hanging drops of mixed syrup having a density of 70 per cent or again expressed in atmospheres 225 to 260. Yeasts did not grow in the purest cane syrup (c.p) of 68 per cent. total solids Cream centers of chocolate coated candies inoculated with sugar tolerant yeasts burst after a period of storage normal for ripening such confections The syrup density of the expressed syrup phase of the cream of fondant was 76 to 77 per cent., or greater than 225 to 260 atmospheres.

---

[3] Hackh, *Phys Rev.*, vol 13, p 165, 1919, and *Phil. Mag*, vol. 39, p. 155, 1920.

[1] W. Pfeffer, trans. by A. J Ewart, "Physiology of Plants," Vol. I, pp. 136, 146. 1906.

Summarizing, we may state that yeasts apparently do not grow in solutions of mixed sugars having a density of 79 per cent This concentration appears to indicate the cessation of activity for sugar tolerant yeasts Investigators at the Michigan Agricultural Station have apparently reached the same conclusion.[4] We need to bear in mind, however, that between cessation of reproductive development and cessation of all activity there is a period where enzymatic activity of living cells and finally autolysis of dead cells progresses.

MARGARET B. CHURCH

URBANA UNIVERSITY,
URBANA, OHIO
August, 1931

MORE DATA ON THE LUNG FLUKE, PARAGONIMUS, IN NORTH AMERICA

WALLACE,[1] of the University of Minnesota, has recently found that the mink is the normal definitive host of *Paragonimus* in North America. He examined minks from fur farms. He included a small amount of life history data in his report and in a second article[2] gave a more detailed account of this phase of the work. The work here reported was begun in March, 1930, independently of and without knowledge of Wallace's work. My records show that metacercariae were discovered June 22, 1930, and mature worms secured on September 4, 1930, from an experimentally fed cat The mink was determined to be the normal definitive host in North America without knowledge of Wallace's contribution which was published after my survey of the fur-bearing animals was completed

In the fall of 1929, in connection with another problem, a cat was used that had come from Platt, a small village on the outskirts of Ann Arbor Examination of its feces at the time revealed the characteristic eggs of *Paragonimus* and this diagnosis was verified several months later at the death of the cat when eight adult worms and a large number of eggs were removed from the lungs. On the basis of this discovery, a search for the metacercaria was begun the following spring when various species of crayfishes from local ponds, lakes and streams were examined and on June 22, 1930, a metacercaria closely resembling that of the Asiatic lung fluke was discovered in the pericardial region of 60 per cent of the *Cambarus propinquus*[3] collected in Fleming Creek, a stream several miles east of Ann Arbor Cysts were fed at intervals to a cat which developed the characteristic *Paragonimus* cough On September 4, 1930, ten weeks after the first experimental feeding, the cat was killed and forty-three worms of various ages as well as thousands of eggs were recovered from the lungs. Subsequent examination of crayfishes from the same stream revealed that *C robustus* also harbored the metacercariae but very few individuals were infected. The cysts are usually found in the wall of the heart or adhering to it, though occasionally some are found either attached to the tissues surrounding the pericardial cavity or free in the lumen of any of the large blood vessels leaving the heart. In heavy infections, the majority of the cysts occur in clusters arranged in a belt across the broad base of the heart Even in the heaviest infections, the cysts are absent from the gills or muscles In the fall, collections of stream crayfishes taken from all parts of the lower peninsula to determine the distribution of the worm in this part of the state, added another host species, *C. virilis*. Wallace found metacercariae in a single species, *C. immunis spinirostris* Apparently any species of crayfish occurring in the appropriate environment will serve as an intermediate host though some species prove to be more capable hosts than others

---

[2] *Ibid.*, p. 140

[3] Wm. L Owen, "Swells in Canned Cane Syrup and Molasses," "Facts about Sugar," 21, pp. 946–9, Oct. 2, 1926.

[4] F. W. Fabian and R. I. Quinet, "A Study of the Cause of Honey Fermentation," Mich. Agr Sta., *Tech. Bull.* 92, pp. 1–41, 20 figs, Feb., 1928.

[1] F. G. Wallace, "Lung Flukes of the Genus Paragonimus in American Mink," *Jour. Am. Vet. Med. Asso.*, [illegible] 225–234, 1931.

[2] F. G. Wallace, "The North American Lung Fluke," SCIENCE, n. s., 73: 481–482, 1931

[3] The writer is indebted to Mr E. P Creaser, of the University Museums, for identification of crayfishes.

To determine the distribution of the lung fluke and its normal host in Michigan, there were secured from trappers all over the state, during the 1930 trapping season, 1,011 carcasses of fur-bearing animals consisting of 563 minks, 308 raccoons, 109 opossums, 22 weasels, 8 muskrats and one badger The flukes were found only in minks of which 17 per cent carried the infection Though raccoons are voracious eaters of crayfishes they are apparently immune to lung fluke infection A raccoon which had been fed hundreds of cysts, during the summer of 1930, was found to be negative upon examination in the fall An attempt is now being made to infect young raccoons An unsuccessful attempt was made to infect an opossum following the examination of the carcasses No sign of infection was found in 241 carcasses of wild muskrats examined in connection with a former problem though a feeding experiment demonstrated that muskrats are capable of infection The 8 muskrats reported above were examined because they had been caught in Honey Creek, a stream in which all the *C propinquus* examined, as well as a high percentage of the *C robustus,* were infected *C propinquus* from this stream not uncommonly yield 40 metacercariae while one yielded 75

Paragonimus occurs rarely in cats or dogs. Though thousands of cats and hundreds of dogs are examined annually in laboratories, this obvious pulmonary infection is seldom reported. The rarity of the infection in these animals is explainable on the basis of their food habits It is generally believed that the various mammalian hosts of *Paragonimus* obtain their infection through the eating of fresh-water crabs or crayfishes but to my knowledge it has never been proven that cats or dogs eat these crustaceans On two occasions both living and dead crayfishes were placed before the naturally infected cat from Platt following several days of starvation but she did not display the slightest interest in them This same cat at various times eagerly ate the flesh of wild mammals and birds, even hawks and owls, though cooked food was in the cage Another cat manifesting the same attitude toward wild food could not be induced to eat crayfishes after two days of starvation[4] This experiment has not yet been tried upon dogs If cats and dogs do not eat crayfishes, the only other possibility of their securing *Paragonimus* is by eating the final hosts containing recently ingested metacercariae or slightly developed worms, thus acquiring their infection secondarily That this method of transmission is possible, at least with worms not exceeding twenty-four hours' sojourn in the final host, was demonstrated when two rats fed one hundred metacercariae twenty-four hours previously were forcibly fed to a dog. On examination two months later, four young adult worms were found in two cysts in the dog's lungs.

Though it is the consensus of opinion that nothing will eat a mink, data have been collected to prove that both cats and dogs do occasionally eat them Accounts of personal experiences on this matter were solicited from trappers of minks Out of thirty-three replies, three trappers stated that they had seen dogs eat minks One trapper reported that he had seen cats eat minks while still another replied that cats do eat minks but he did not indicate that he had witnessed the act Two other trappers volunteered the information that they had seen foxes eat minks

When the collection of carcasses of fur-bearing animals mentioned above was being made, the fresh carcasses of minks were given to each of four cats Two of the cats would not touch the carcasses while one ate the liver, lungs and muscles when they were removed from the carcass and given to it separately The fourth cat, an exceptionally large animal, at the regular feeding time ate the entire thorax of a mink and might have eaten more had not the remainder been removed

Further studies on the various aspects of the *Paragonimus* problem are under way and will be reported upon from time to time

DONALD J AMEEL

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF MICHIGAN

---

[4] Since this manuscript was submitted two of my cats, when starved, have eaten crayfishes.

BOOKS RECEIVED

BROOKS, F T and T F CHIPP, Editors *Report of Proceedings of the Fifth International Botanical Congress, Cambridge, 1930* Pp xiv + 680 Illustrated Cambridge University Press $7 00

CARTER, W. T *The Soils of Texas* Bulletin No 431. Pp 189 Agricultural and Mechanical College of Texas

CHAPMAN, ROYAL N *Animal Ecology* Pp x + 464. McGraw-Hill $4 00

DINWIDDIE, COURTNAY *Child Health and the Community* Pp vii + 80 Illustrated Commonwealth Fund $1 00

HALL, SIR A. D *The Soil* Fourth edition Pp xvii + 388 Illustrated Dutton $3 00

LENZEN, VICTOR F *The Nature of Physical Theory.* Pp. xii + 301 Wiley $3 50.

PISTON, DONALD S *Meteorology* Pp viii + 187. 81 figures Blakiston $2 50.

SKRIFTER OM SVALBARD OG ISHAVET D. SOKOLOV and W. BODYLEVSKY *Jura- und Kreidefaunen von Spitsbergen.* Pp 149 Illustrated. GUSTAV SMEDAL· *Acquisition of Sovereignty over Polar Areas* Pp 143. B. LYNGE *Lichens Collected on the Norwegian Scientific Expedition to Frans Josef Land, 1930.* Pp. 81. Illustrated. Jacob Dybwad, Oslo

WOOD, CASEY A., Editor *Introduction to the Literature of Vertebrate Zoology.* Pp. xix + 643. Illustrated. Oxford University Press. $15.00.

SCIENCE

VOL. 74 FRIDAY, NOVEMBER 20, 1931 No. 1925

Pure and Applied Science PROFESSOR CECIL H DESCH 495

Schaudinn. A Biographical Appreciation. PROFESSOR JOHN H STOKES 502

Scientific Events
The University of Wisconsin Research Patents, The Biological Photographic Association, The Tulsa Meeting of the Geological Society of America, The Seventh Pan American Scientific Congress, The American Institute of Physics 506

Scientific Notes and News 509

Discussion.
Oestrus REVEREND DR STUART L TYSON *Possible Significance of the Decreased Suspension Stability of the Blood* · HOBART A REIMANN *Fossils from the Eastern Flank of the Sierra Nevada, California* EVANS B MAYO. *Naming Disorders of Speech* SAMUEL D ROBBINS *A Curious Fish Story* DR. C T HURST 512

American Association for the Advancement of Science
New Orleans Meeting, December 28, 1931–January 2, 1932 · DR. CHARLES F ROOS 516

Scientific Apparatus and Laboratory Methods
A Method of Supplying Students with Natural Endamoeba Histolytica from Cultures. J H ST JOHN *Photographing Animals* ARTHUR L KAHN and GEO H HANLEY 519

Special Articles
Accelerated Infection in Experimental Poliomyelitis DR SIMON FLEXNER *The Ring Structure of Adenosine* · DR. P A LEVENE and R STUART TIPSON *Alaria Mustelae sp nov, a Trematode Requiring Four Hosts* DR NELLY J BOSMA *The Relation between Iron, Humic Acid and Organic Matter in the Nutrition and Stimulation of Plant Growth;* DR. DEAN BURK, HANS LINEWEAVER, C KENNETH HORNER and DR. F E ALLISON 520

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

PURE AND APPLIED SCIENCE[1]

By Professor CECIL H. DESCH

UNIVERSITY OF SHEFFIELD, NON-RESIDENT LECTURER IN CHEMISTRY AT CORNELL UNIVERSITY UNDER THE GEORGE FISHER BAKER FOUNDATION

IN entering on the duties of the George Fisher Baker lectureship in Cornell University, I must first express my high appreciation of the great honor done to me by the university by its invitation, and of the great personal kindness and helpfulness of Professor Dennis in all matters concerning it.

Only a short time ago Mr. Baker, to whom this university owes so much, passed away, full of years and honor. Education in America has been singularly fortunate in attracting the support of many wealthy leaders of commerce and industry, and the results are to be seen in such magnificent buildings as this in which we meet, and in the facilities given for the interchange of students and teachers between different institutions and different countries. The visiting lectureship which George Fisher Baker founded in this university has been the means of bringing a number of European workers in various branches of science related to chemistry to Cornell and has given to them an unrivaled opportunity of seeing American university conditions at their best and of exchanging ideas with a new and keen group of students and colleagues.

With the possible exception of music, no form of human activity is so independent of national barriers as scientific research, and every step that brings into closer connection the scientific workers of different countries deserves a warm welcome. Judging by the enthusiasm and the affection with which my predecessors in this lectureship have spoken to me of their stay at Cornell, this scheme, which we owe on the one hand to Mr. Baker and on the other to Professor Dennis, must rank high among such efforts at international cooperation.

Previous lecturers have dealt with different branches of pure chemistry and of sciences allied to it, but I believe that I am the first whose teaching duties are definitely concerned with the application of science to industry, and I ask you to allow me to consider in this opening address some aspects of the relations between pure and applied science.

---

[1] Introductory public lecture.

As I left London, scientific men of many countries were assembled there to do honor to the memory of Michael Faraday, the occasion being the centenary of his discovery of electromagnetic induction From that discovery has grown the whole of the modern electrical industry, for without it there would be no electric generators or motors, no radio-transmission, no generation of current except on the smallest scale At the Faraday exhibition now open in London, the statue of the discoverer occupies the center of the large circular hall, and is surrounded by cases containing the apparatus used in his early experiments From each of these extends a sector, illustrating the developments in electrical science and practice which may be considered to owe its origin to those experiments Yet Faraday was an "experimental philosopher," one whose sole aim was to learn something of the workings of nature He had in mind no practical application of his discoveries, and never concerned himself with the invention of machines He was even skeptical of the possibility of using electromagnetic methods in place of the primary battery His work was guided throughout by the purely theoretical conviction of the unity of natural forces, which led him to seek for the connection between electricity, magnetism, light, chemical action, and even, although at the time without success, owing to the minuteness of the effect, which was afterwards found in our own day, with gravitation

It was not from any contempt for practical objects that Faraday confined himself to work in pure science He was always ready to assist the state and public bodies by his advice when it was invited, notably in his work for Trinity House, the authority which in England controls the lighthouses on our coasts At the same time, caring nothing for wealth, he refused to be tempted by the offer of large sums to enter industry and to devote his genius to immediate practical objects Little as he would have expected it, industry has gained enormously by his decision to investigate fundamental principles He actually produced, in the course of his experiments, the first dynamo-electric machine—a copper disk rotating between the poles of a magnet and supplying continuous current to a pair of brushes in contact with it—but he took no part in its development, although within a very few years machines based on his principles were constructed and brought into practical use by others

The complexity of modern science, and the large number of workers in almost every field, make it unlikely that future Faradays will be able to open up a new region with the same completeness, but it remains true that practical inventions mostly arise as the unforeseen by-products of studies which had as their aim the discovery of relations between the phenomena of nature

There has lately been presented to us an entirely different view of the relations between pure and applied science A striking incident at the International Congress of the History of Science held in London this summer was the appearance of a number of scientific delegates from Soviet Russia, prepared with papers which were immediately published with the title of "Science at the Cross-Roads" In these papers the thesis was maintained that scientific research carried out for the satisfaction of intellectual curiosity is anti-social, and that henceforth research must be directed towards some practical end, having direct value for the community This is not to say that science is to be confined to mere technology—the distinction attained by some of the speakers in their own fields of science would make such a statement a caricature of their views—but the possibilities of application are to be kept in mind throughout This view of the science of the future, although taken, with the other principles of the Soviet system, from Karl Marx, had been maintained earlier by Auguste Comte, who held that the need for knowledge in certain fields of importance to society was so imperative that it was the duty of men of science to concentrate, at least for a generation or two, on the solution of a few problems, to the exclusion of researches dictated only by curiosity, of however high an intellectual order Comte did not foresee the great unification of science, beginning with the doctrine of the conservation of energy, that was in progress during the later years of his life, and Marx, a much less profound thinker, was so obsessed by the purely economic problem as to fail to understand the real meaning of science

The Soviet theory claims an historical basis It is argued that all scientific research had its origin in practical needs This is true of the first beginnings of science The study of the stars was a necessity of pastoral races to guide their wanderings, and geometry, as its name signifies, was originally land surveying, necessary to the settled agriculturalists. But after these beginnings science took its own course. Astronomy and mathematics were studied for the new knowledge they gave, without care for possible applications Plato's conception of pure science, which would limit its scope to the most abstract part of the mathematical sciences, was that of a philosopher and not of an experimental investigator, but it would be absurd to say that it was anti-social. Ever since the foundations of abstract science were laid by the Greeks, men have felt, instinctively or on the ground of a definite theory of life, that the disinterested search for knowledge was good in itself, and worthy of the best human effort.

Suppose, however, that we admit for the moment that the desire to satisfy intellectual curiosity is a selfish one, and that the world needs an answer to many problems that affect the welfare of mankind, does it follow that scientific research should be confined to those problems with the object of obtaining, by combined effort, the most speedy result? Experience teaches the contrary The history of the transmission of messages by electric waves has often been told, but it would be hard to find a more striking illustration Eighty years ago the electric telegraph was well known and understood Let us suppose that electrical engineers had been asked to discover a method which would dispense with the wire or wires connecting the sending and the receiving stations The supposition is absurd, for there was nothing in the known properties of the electric current to suggest such a possibility, but it is safe to say that if a team of workers trained in telegraphy had been instructed to find such a method they would have met with no success, even after years of combined effort The actual history of the solution is very different Faraday, who had no mathematical training and never used a mathematical symbol, nevertheless stated his conception of the electro-magnetic field in such a way that Clerk Maxwell was able to give it mathematical shape and to deduce the formal equations from which it followed that changes in electric or magnetic force must be propagated as waves This was verified in 1888, nearly ten years after Maxwell's death, by the brilliant experiments of Heinrich Hertz Electric waves had actually been observed earlier by Joseph Henry at Princeton, but the observation had not been followed up Transmission over a distance of a few feet having once been achieved, the later development of wireless telegraphy and telephony, extraordinary as it is, has been mainly in the application of known principles by skilful engineers and inventors The greatest single step in that advance, the invention of the thermionic valve or tube, which has made modern radio-transmission possible, arose from investigations of the emission of electrons from heated solids, investigations which appeared at the time when they were undertaken to be as remote as possible from any practical application. As the uses of the original invention multiply, and as greater and greater refinements of technique are required, the discoveries of pure physics in the most varied branches are pressed into service. The photo-electric properties of certain elements and compounds, the variation of the electric properties of quartz crystals with changes of pressure, and the action of organic liquids on the plane of polarization of light, are examples of such phenomena. All of them were discovered in the course of pure research in physics, without thought of practical use, and again illustrate the fact that important inventions are in the main the by-products, rather than the intended results of scientific research

In an interesting address delivered to the Society of Chemical Industry in 1928, Dr Irving Langmuir described how experiments, at first intended to improve the vacuum in incandescent lamps, led him into research on the liberation of gases from heated bodies, with results of great interest for pure science The enlightened policy of Dr Whitney and the General Electric Company made it possible for him to pursue this line of research, although it seemed unlikely to lead to any results of practical use In the end, it led to the gas-filled lamp, an invention of very high value, but quite different from the original object of the research It is in America particularly that great corporations, which possess exceptional facilities for research, such as the laboratories of the General Electric Company at Schenectady and those of the Bell Telephone Company at New York, have taken such a broad view of their functions as to allow members of their staffs showing great experimental ability to follow an interesting line of investigation even though it might appear to have no immediate practical object.

I must not be unfair to the Soviet delegates They would readily admit that results of value may be reached by indirect means, but would claim that the investigator must always have utility in view, and must not regard himself as free to follow any interesting line of study that may happen to appeal to him For the spontaneous activity of individual workers they would substitute the organized labor of skilled teams

A feature of the Marxian theory of science is its virtual denial of the importance of genius It will be found that every great discoverer has had precursors and contemporaries in the same field Oersted, Ampère and Arago had discovered important relations between electric and magnetic effects before Faraday, whilst Joseph Henry independently made the same observation of electro magnetic induction The subject was engaging attention, and it is easy to argue that if Faraday or Newton had never lived the discoveries that we associate with their names would have been made by others without very much delay. In that there is an element of truth Since the picture of the universe which science constructs becomes one that is accepted as true by all those who have the training necessary to appreciate it, we are bound to believe that those regularities which we call laws will be discovered in course of time But the progress of discovery is enormously hastened by the advent of a man of genius Ostwald's comparison of the genius with a catalyst is a good one The catalyst does not alter the final state of a chemical reaction, but it may very greatly accelerate it. No one can examine the writings of Newton or Faraday without feeling that the transformation of science brought about by their work was of an entirely different order from that of even their most gifted contemporaries and that the pace of scientific discovery was almost immeasurably quickened in consequence. It is not an isolated experiment or series of experiments by Faraday that is now being commemorated, but a conception of the electromagnetic field based on those experiments, so perfect that it has been adopted by all later students. We can only regard it as a work of genius It would be absurd to imagine that, if Shakespeare had never lived, "Hamlet" would sooner or later have been written by another hand or, if the task had proved too great for one man, then by a duly appointed team of writers. Scientific discovery is not strictly parallel with literary creation, but sufficiently so to make us conscious of the essential services of genius in that field also.

In the subsequent lectures of this course there will often be occasion to refer to the use of the microscope in the examination of minerals and metals. We owe these methods to a Sheffield amateur, Henry Clifton Sorby, who fully deserves to rank as a genius, although on a lower plane than Faraday. Free from all duties of teaching or administration, Sorby devoted himself to independent research in science, studying rocks, strata, meteorites, steel, plants, animals and archeological remains with that insatiable curiosity which marks the born discoverer In every field he added new knowledge, but he is the undoubted founder of two branches of study, microscopical petrology and metallography, both of which have grown to great dimensions, and have proved essential tools in both pure and applied science In a plea for "Unencumbered Research," published in 1876, Sorby urged that the research worker should be left entirely free to choose his path, with the assurance that the real investigator, if we can find some way of recognizing him when young, before he has been forced into a mould, will produce the best results if left unfettered.

This is not to belittle the team work which is so necessary in the application of scientific results to industry, agriculture, medicine or other practical ends Those activities depend on science to an extent undreamed of in Sorby's time, and our great laboratories of applied science call for increasing numbers of research workers trained in pure physics, chemistry and biology, in addition to those whose education has been given a special technical bent But we must have in the universities groups of "unencumbered" workers free to choose their own line of research and pursuing it for the love of scientific discovery alone, or the organized team work will before long flag and languish from lack of inspiration.

The art of smelting metals is an ancient one, and until the eighteenth century it was almost entirely empirical. The trade of the smith, in all its varieties of form, was one of the most rigidly preserved of crafts, since its success depended so entirely on the traditional skill of the craftsman A few men of scientific insight, such as the German Agricola in the sixteenth century, had sought to reduce the knowledge of the art of smelting to some order, and to free it from the grosser errors and superstitions, but it was a few chemists of the eighteenth century, notably Réaumur in France and Swedenborg in Sweden, who made intensive studies of certain branches of metallurgy and sought to place them on a scientific basis Their writings are of interest to us to-day. Nevertheless, the empirical character of the art persisted, and truly scientific metallurgy is of quite recent date. The influence upon it of researches in pure science is perhaps best seen by considering, not the smelting of metals from their ores, but their treatment to give useful products. In the steel industry, so long as cast and wrought iron and such steels as those used for cutlery were the only known materials, empirical methods answered well enough, but with the expansion of the industry brought about by the invention of new steel-making processes it became necessary to consider, for instance, the effects of carbon in modifying the properties of iron. The physical chemist was called in, and the first draft of the iron-carbon equilibrium diagram by Bakhuis Roozeboom in 1900 marks the beginning of a new era. About the same time, Heycock and Neville carried out an investigation of the alloys of copper and tin, using microscopical and thermal methods, and setting a standard of accuracy which profoundly influenced later work. It was now seen that changes may proceed in solid metals in such a way that, without any alteration in chemical composition, materials of entirely different properties may be obtained by varying the rate of cooling The hardening of steel by quenching in water, in use for more than 3,000 years, is only one of many such processes which are employed in metallurgy. Gradually, the microscope and the thermoelectric pyrometer have come to be essential tools in metallurgy, and micrographic analysis supplements chemical analysis in all works laboratories.

Besides undergoing thermal treatment, metals and alloys are subjected to mechanical processes, such as rolling and wire-drawing, which profoundly modify their properties. Empirical knowledge and skill have done much for the perfection of those processes, but it has been found that they can not be utilized to the best advantage without an understanding of the internal mechanism of the change. Metals are made up of crystals, so the metallurgist has called to his aid the work of the crystallographer. Whilst the older [illegible] metrical crystallography could only indicate in a general way the nature of the changes during deformation, the newer study of crystals by means of their x-ray diffraction patterns throws a flood of light on the process In consequence, the x-ray tube is taking its place with the chemical balance, the microscope and the pyrometer as one of the essential tools of the metallurgist There are others. Many metals are greatly influenced by the presence of very minute quantities of impurities, sometimes so small that chemical detection is difficult or impossible. Here the quartz spectrograph, capable of following the spark or arc spectrum into the ultra-violet, renders great service, and is rapidly making its way into manufacturing plants as well as into research laboratories as a standard means of control. Magnetic measurements afford another means of studying the composition and internal condition of metals, so that we find, in some large steel plants, the estimation of the quantity of carbon dissolved in the bath of a large open-hearth furnace carried out by casting a small specimen and determining its magnetic properties, the method being accurate and at the same time simpler than a chemical analysis In another class of manufacturing operations, magnetic measurements are used as a means of deciding whether steel objects, made in large quantities, have received the proper heat treatment, where formerly a number of objects from each batch had to be tested mechanically to destruction in order to obtain the information now gained at a fraction of the original cost. All these methods of testing have been adopted from the laboratories of pure science and have been turned to new uses It is thus one of the services of pure science that it furnishes applied science with new tools of research and means of measurement. On the other hand, the increasing demand on the part of the workers in applied science for such tools acts as a continual stimulus to investigations in physics.

Some metals, notably tungsten, have in our own time passed from the state of chemical curiosities to that of important technical products, by methods which are essentially those of the physical research laboratory. No one can visit one of the great lamp or radio-tube works without feeling that the manufacturing department is essentially an enlarged laboratory, employing methods which only a few years ago were confined to the research worker. We have the paradoxical result that the physical constants of tungsten are known with much greater accuracy than those of the more common metals, whilst of the metal, iron, manufactured by hundreds of millions of tons, the data as to its properties in a pure condition are singularly imperfect.

An example of the changing character of applied science may be seen in the study of corrosion. The most important of our useful metals, iron, steel, copper, brass, aluminum and so on, are all liable to undergo corrosion, to an extent which involves colossal annual losses Protective methods have been devised empirically, but of late years much has been done to develop the use of metals which are in a sense self-protecting, in that they quickly form a layer, probably only a few atoms thick, which resists chemical attack. The "stainless" steels belong to this category. Looked at theoretically, this form of protection may be traced back to the work of Faraday and Schoenbein on the passivity of iron, although the connection was not at first recognized. It is important for the manufacturer and the user to have some means of determining in advance how a given metal will behave under given conditions of exposure to corroding agents. With this object, many hundreds of thousands of tests have been carried out in scores of laboratories, every effort being made to obtain a standard test, but the results have been singularly disappointing There is no form of rapid test which will indicate with certainty how a metal will behave when it is exposed for periods of years Such empirical and *ad hoc* methods are now supplemented by studies of the fundamental nature of corrosion The methods of the physical chemist have been adopted, and laboratories devoted to work on corrosion now combine measurements of the absorption of oxygen with those of electrolytic potential and of the microscopical examination of the formation and rupture of surface films. In this way an intimate knowledge of the process of corrosion is being gained, by the help of which the choice of resistant materials may be guided in the future with greater certainty

In its turn, applied science reacts on pure science The problems raised by the working of metals, for instance, have given a great stimulus to the study of the deformation of crystals, with a corresponding effect on molecular theory Moreover, the needs of the technical laboratory and works lead to the construction of instruments of measurement which are continually improved for practical use, and are in turn adopted by the research workers in physics and chemistry. Such mutual influence counts for much in the advance of science. To turn now to another aspect of the subject

That we can not fully appreciate a scientific principle or discovery without some study of its history is a truth more and more vividly realized by those whose business it is to teach science to students A knowledge of the steps by which a scientific doctrine has been built up or an invention brought to perfection is necessary if we are to estimate aright its value and importance. As we must not undervalue the services of genius, so we must not, on the other hand, isolate a few famous discoverers and neglect their predecessors and contemporaries The study of the history of a science is now widely recognized as an integral part of a training in that science It would be well if the same view were taken in the teaching of applied science and technology, and in this field it is not difficult to enlist the interest of students Here is also one means of bridging the gulf, so deplorably wide in the highly specialized education of the present day, between scientific and humanistic studies The history of an applied science or of an industry depending on it may be brought very simply into relation with the state of society at successive epochs May I again illustrate this point by a few references to the study of metals? A short account of the history of the first use of metals by man may well open a course of lectures on general metallurgy The first metal known was gold, since it is found in the beds of rivers in the uncombined state, resists tarnishing and by its gay color and luster appeals to the decorative instincts of Stone Age man It is too soft to be used for any purpose but that of ornament Copper follows, at first used as the native metal, but later obtained—no doubt in consequence of the accidental fusion of the conspicuous green surface ores in domestic fires—by smelting These masses of copper, which can be cast in an open mould and can be so hardened by hammering as to take and keep a cutting edge, inaugurate the first Metal Age The next step, the production of the much harder alloy, bronze, which may be cast in closed moulds, is an immense advance, and its origin is one of the unsolved mysteries of metallurgical history Iron, sporadically used from quite early times in the form of objects forged from meteorites, is only smelted at a later period, but the steady supersession of bronze by iron is important and may be sketched A simple account of these archeological facts, showing how the objects characteristic of each stage bear, in the earliest forms, clear traces of their origin in the copying of older objects in a new material, encourages an interest in the history of the older civilizations The part played in the movements of races and in the history of nations by the search for metals is an important one, and recurs again and again, as in the events which followed the discovery of gold and silver in Central and South America by the Spaniards, and in the Californian and Australian gold rushes of the last century Or, turning to iron and steel, it may be shown how the introduction of the steam engine, which brought about the industrial revolution by substituting machinery for hand labor, was itself made possible by metallurgical improvements, notably by the substitution of coke for charcoal in the blast furnace and by the invention of puddling. In the second half of the last century, the Bessemer process began that enormous increase in the rate of growth of the heavy industries which has been one of the chief features of the economic history of the world in our own time When the university, as at Sheffield, is situated in a town having a metallurgical history possessing special features and extending over several centuries, local history may be linked up with the technical teaching

These illustrations are introduced not for their practical importance, but because they widen the interest of the student, and encourage him to include in his private reading some study of the history of industrial communities Such a study, if well pursued, may prove in the end to have practical value also in enabling those on whom the responsibility of directing and controlling industry may fall to understand better the social and economic conditions in which they have to work Where a Social Survey is in progress, students of science and technology having some background of historical knowledge can be among the most useful voluntary workers

In the teaching of the history of a pure science, stress is naturally laid on its value for the understanding of that science in itself, but in a balanced education it would seem that it should have a further value The development of scientific thought is such an essential part of the history of civilization that it should be prominent in the teaching of general history, but this view only makes its way slowly.

There is another aspect of the relation of science to the community The public conception of science is commonly limited to the mathematical, physical and chemical sciences, with the many departments of biology and their applications and in recent years, psychology The great field of social studies is usually, at least in Europe, regarded as outside the field of science, with the single exception of economics. However, if prediction be the test of science, economics has not been, in the last few years, conspicuously successful

It has been the aim of many thinkers to build up a science of human society, to embrace not only economics but all the activities of man Sociology, to use the name coined originally by Comte, is the most difficult of the sciences, because it deals with phenomena of far greater complexity than any of the physical or biological sciences Few of its principles have yet been established, and it must still be regarded as a science in the making, but its importance is such as to deserve the attention of all students, in spite of the urgent claims made on their time by their chosen specialism I believe that this fact is more generally recognized in America than in Europe, but nowhere is the treatment of social problems, such as those of politics and finance, scientific to the extent that would be desired by the sociologist, and it would seem that those who already employ scientific methods of reasoning with success in one field could render service in bringing about their extension to others

Science, in its applications to technology, has made available to mankind forces incomparably more powerful than those of a few generations ago The command over natural forces has so increased the scale of production that we appear to suffer from an excess rather than from a deficiency of products, agricultural as well as industrial Yet, although the standard of life has risen, the community to-day is faced by problems as difficult and dangerous as at any time in the world's history, and the growth of industry has as yet by no means brought all the happiness that was once expected of it.

Moreover, the application of science to warfare has greatly increased its horror, and it is certain that in another war, if such should occur, all the resources of science would be pressed into service to increase that horror still further The means furnished by science may be used for the great benefit of mankind or misused in such a way as to cause misery Is it not, then, desirable that all who are concerned with the advance of science by research or with its application to practical uses should interest themselves in the difficult problem of its use for the benefit of mankind? In other words, must not the chemist or biologist seek to become, in however modest a way, a sociologist, seeing that he can not divest himself of responsibility for the uses to which science is put?

Here, again, applied science serves as a link The progress of pure science occurs within a limited circle of specialists, and contact with the general public only becomes marked when some question having a popular appeal emerges, as in the present-day interest in astronomical speculations as to the structure and fate of the universe. On the other hand, the contacts between applied science and the community are perpetual, and every worker in such a field must have some consciousness of its social significance

The fact that in science international barriers have disappeared, or are reduced now to the minor obstacles due to differences of language, makes it easier for the scientifically trained man than for another to appreciate what international conditions mean in the modern world It is science that has speeded up communications by land, water and air, that has brought most countries within speaking distance of one another, and that has largely destroyed the strategic value of natural frontiers In doing so it has solved some problems and created others It has become clear that the natural resources of the world are not inexhaustible, and that unless steps be taken to conserve them by using them as efficiently as possible, our descendants will find them dangerously depleted within an easily calculable time. Those resources are of the nature of capital, and once consumed can not be renewed It is far otherwise with the power derived from water or, as may be practicable in the near future, from the direct heat of the sun; with the annually renewable products of agriculture, or the analogous products, harvested at longer intervals, of forestry A scientific view of the matter would stress the importance of making greater use of the second source of wealth, which has been, in most countries, so much subordinated to the former I do not know how it may be in America, but in Europe our political leaders and our economic authorities are, in an overwhelming proportion, urban in outlook

A great Scottish scientific teacher, Professor Patrick Geddes, has pointed out that there is not one Industrial Age, characteristic of the modern world, but that two may be distinguished These he has called, borrowing an analogy from the archeology of the Stone Age, the Paleotechnic and the Neotechnic In the first, of which the most conspicuous illustration is the condition of England in the generations following the invention of the steam engine, the discovery of means of accumulating riches faster than had been dreamed of before led to an enormous extension of industry, unplanned and without safeguards against its abuse This meant the reckless exhaustion of coal and minerals, and in the earlier decades a callous disregard on the part of many industrialists of human health, comfort and safety Evils grew up in the industrial regions which had to be fought by philanthropic effort and by legislation Other nations followed suit at such a short interval that whilst some of the evils were avoided, yet on the whole an absence of planning for social benefit was as conspicuous as ever Gradually, signs of a passage to the Neotechnic Age are becoming apparent The more scientific use of fuel and the increasing replacement of the smoke and dirt of coal-fired furnaces by the bright cleanliness of electric heating marks the transition. A modern power station using water power may stand as a symbol of this age The health and welfare of the workers become a first consideration The conservation of natural resources, in minerals, forests and water is regarded as a national and an international duty Intelligent planning takes the place of haphazard development for merely private advantage. Whatever may be the economic system of the future, it must surely involve such planning, with a recognition of duties that leaders of industry, whether private or public, owe to the community Of the moral aspects of the transition, all-important as they are, this is not the occasion to speak.

It is naturally more difficult to maintain a strictly scientific attitude on questions of politics, social organization and finance than on those of atomic physics, since our personal interests are involved, but that the attempt should be made is a conclusion which forces itself on a student of science who lives and works in an industrial community Most of all, at such a time of crisis as this, does the need of scientific thought impress itself on us By widening the conception of science to include sociology, whatever form that incipient science may take, it should be possible to increase very greatly the influence of systematic observation and reasoning, which is what we mean by science, on human life.

From the point of view of the general influence of science the recent tendency to lay emphasis on the uncertainty of scientific prediction in atomic physics is unfortunate The "principle of uncertainty" is really a confession of ignorance, and it is to be expected that as the theoretical treatment of problems in the structure of matter advances, means will be found of reconciling the difficulties now experienced. It would be unfortunate if an impression were to gain ground among the public that science has abandoned its claim to accurate prediction The cases in which prediction fails, according to the principle just mentioned, are confined to a difficult section of physical science which has only recently come under discussion. It would be entirely premature, on the strength of such new conclusions, to abandon the principle of determinism which has hitherto served its purpose so well in the sciences.

The inspiration of modern science must come from the original investigators, seeking for nothing but a more profound understanding of the workings of nature, and provided with the facilities for observation and experiment. Linked with them in the most intimate contact that the organization of university and industrial laboratories can make possible, come the workers in applied science, connected closely on the other hand with the technologists, charged with carrying into practice the results of scientific research It is neither necessary nor possible to draw sharp dividing lines between those classes, but they may be broadly distinguished All may unite in doing honor to great discoverers, such as Faraday, for all alike may trace their activities back to the products of their genius.

SCHAUDINN

A BIOGRAPHICAL APPRECIATION[1]

By Professor JOHN H. STOKES, M.D.
SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

WE are assembled to-night to memorialize a man, and an occasion. Let us begin with the man

Fritz Schaudinn was born at Roeseningken, a village in East Prussia, on September 19, 1871 Thirty-five years later, on June 22, 1906, he died of septicemia and collapse at Hamburg Into this short life-span he compressed activity and achievement that placed him in the ranks of genius

Of his family and antecedents practically nothing appears in the accessible published sketches and eulogies. His gymnasium education was carried through at Insterburg and Gumbinnen In 1890 he began his preparation for a career in philology, but by the fifth semester at the University of Berlin was definitely embarked on his life-work as a zoologist, and by his thesis for the doctorate in 1894 committed himself to parasitology, then the infant of the zoo-medical sciences In July, 1894, from Bergen, Norway, and again in a trip to the Arctic in 1898, he gathered material, published subsequently with Roemer as junior, for a massive communication on the fauna of the region In October, 1894, he had been appointed assistant in the Zoological Institute in Berlin, and in 1898 achieved his docentship. During this period appeared a number of papers on the reproductive processes in Protozoa, which broke new ground repeatedly and foreshadowed distinctive investigative powers His contributions with Siedlecki on the Coccidia were especially valuable, and Schultz has rated the account of the complete life cycle of *Eimeria Schubergi*, which appeared in 1900, as an example of the ideal in research, in that it has been impossible since to add one single fact to the material discussed by Schaudinn. In 1899 his contacts with medical protozoology began, in the confirmation and amplification of Ross's observations on the malarial parasite. A mission for the German government, which kept him at Rovigno from 1901 to 1904 to study the pathogenic protozoa, led to his appointment as director of the new division of protozoology in the Imperial Public Health Service. At this time the insistent publicity given by Schulze to Siegel's supposed protozoal cause of syphilis, the *Cytorrhyctes luis*, led to a request made by Köhler, president of the Gesundheitsamt, that Lesser, the head of the Clinic of Dermatology and Syphilis at Berlin, cooperate in a joint clinical and parasitologic study of the problem. Schaudinn, who had already been in contact with Lesser and Hoffmann on the matter, was designated as the protozoologist, and Hoffmann was selected by Lesser as the syphilologist to pass upon and make histopathologic studies of the material submitted to Schaudinn for study Neufeld and Gonder, Schaudinn's assistant, joined the investigation, the former to control the animal experimental phase Schaudinn's pioneer work on spirilla, especially in the blood of birds, and his studies of the life cycles of *Halteridium* and *Leucocytozoon Ziemanni* made him the obvious leader of the group Novy rates his acquaintance with extremely minute spiral organisms thus obtained as a principal factor in the extraordinary discovery which followed In the *Halteridium* study, although directed at a miscue, Schaudinn had named and described the genus Spirochaetae, remarked on their extreme minuteness, expressed the belief that they might be filterable, and even went so far as to suggest that yellow fever might be caused by similar organisms.

---

[1] Read before the Section on Medical History of the College of Physicians of Philadelphia at a meeting to commemorate the discovery of the cause of syphilis, November 9, 1931.

In the late winter and early spring of 1905 the investigation got under way, with an admirable selection of material, limited to the most infective lesions On March 3, Schaudinn, in the room devoted to the investigation in the women's clinic of the old Charite in Berlin, saw the *Spirochaeta pallida* in numbers in a fresh preparation made by Hoffmann from an eroded syphilitic vulvar papule, using a Zeiss apochromatic objective with ordinary illumination He then demonstrated the specimen to E Hoffmann and to Neufeld. Secretions from a pointed condyloma were found apparently in the same session or in one immediately following, to contain spirochetes likewise, but the morphologic differences between *Sp refringens*, later so named by Schaudinn, and *Sp pallida* seem never for a moment to have been in doubt in his mind, although the final demonstration of their disparateness required further study The work carried through between this date and the preliminary note published by Schaudinn and Hoffmann, presented as a communication from the Kaiserliche Gesundheitsamt (April 10, 1905), included the demonstration of the organism both in the fresh and azureosin (Giemsa) stained specimens of fluid from both open and closed lesions and also from the pulp juices of the satellite lymph-nodes In the film preparations Schaudinn had recognized but did not stress what he regarded as possible resting stages of the organism. This first communication closes with control studies of non-syphilitic conditions and lesions, and with citation of the observations of Berdal and Bataille on spirillar organisms in balanoposthitis circinata, of Csillag in the same condition, and of [illegible] on the occurrence of spirilla in genital lesions and in hospital gangrene and normal smegma Metchnikoff, who with Roux had accomplished the first successful transfer of syphilis to the apes, was drawn into Schaudinn's studies by a letter dated May 2, 1905, and after a careful search succeeded in finding the organisms in the primary lesion of a *Macacus cynomolgus,* and subsequently in other apes, their identity being confirmed by Schaudinn This was followed by Metchnikoff and Roux's announcement to the Paris Academy of Medicine on May 16 On May 17 Schaudinn and Hoffmann formally demonstrated their discovery to the Berlin Medical Society and the announcement to the medical public, with a fuller discussion of the differential morphology of the organisms concerned, together with Levaditi's confirmation from congenital syphilitic material, appeared in the *Berliner Klinische Wochenschrift* The rapidity with which the discovery was taken up by the scientific world is illustrated by the collection recorded by Hoffmann, of 750 titles by the end of December, 1906

In October, 1905, appeared Schaudinn's last publication, a masterly presentation of the spirochete problem in which he foreshadowed his interest in the life cycle and developmental studies which he was not to take up The relation of the spirochetal organisms to trypanosomes and the possible life cycle transformations appear to have raised a controversy among protozoologists which the loss of Schaudinn's genius has left to a large extent unresolved

On January 11, 1905, Schaudinn was called to the directorship of the Institute for Ship and Tropical Hygiene in Hamburg This appointment was a welcome one, for it released him from the bureaucratic atmosphere and executive hack-work of the Gesundheitsamt, which threatened to subordinate his investigative capacity to minor ends, and assured him of unrestricted research opportunity It carried with it a salary which would at once have lifted the burden of meager living which had rested on him and his family during his short working years But the opportunity came too late. The perirectal infection which finally overcame him was already in progress. The journey to the International Medical Congress at Lisbon, undertaken in part in the hope of regaining health, had the opposite effect, and an emergency operation, followed by a period in the Eppendorf Hospital in Hamburg, terminated in a second operation, collapse and death. Three weeks after his death his third child, a younger son, was born.

Twenty-five years is not too short a time in which to begin to accumulate legend centering about a personality whose career has such unmistakable elements of the dramatic as this It is perhaps a tribute to scientific detachment that the eulogies of Schaudinn deal so largely with discussions of his scientific accomplishments, so little and in such general terms with the life history and make-up of the man, himself a biological phenomenon of no mean order. There appears to have been no family background of scholarly and intellectual achievement such as lies behind the Galtonian concepts of inherited ability. The single portrait that survives in the memorial literature, and a few scattered descriptive words, portray him as a physically massive but finely tooled personality, to which are applied the resonant and almost majestic German words, "gewaltigen, imposanten und kraftigen Gestalt." He evidently lived life in outflowing fashion, with robust humor, frankness at times almost too outspoken for his advantage among bureaucrats (witness a brush with Altdorf), and with an enthusiasm, a joyous and sparkling abandon mingled with his love of truth and work that earned the adjectives "schaumenden Lebenslust." His death shocked his friends into a silence in which they could scarcely grope for words to describe the qualities that endeared him to them. Yet he had the grace to make a few enemies. His extraordinary fairness and generosity, in the face of what might well have been and indeed was to others an incentive to small practice, appears in his full, meticulous recognition of his associates in the spirochete discovery. He was beloved of his pupils no doubt for this among other reasons. His closest friends were given a glimpse of the tenderness, the sensitiveness that lay behind this truly magnificent front. His family was the joy of his life, music his release, the piano his instrument to an unusual degree. Those phrases which so untranslatably express the best the German spirit sees in the personal life are freely applied to him—"Gemutigkeit, voll Anmut und Stimmung." He moved with directness upon the worthwhile objectives, bore no jealousies, was indifferent to the side-issues of form and manner that to so many obscure the substance of creative thought. It is easy to imagine, if this is the man, what genuine anguish must have seized those from whom he was taken on the eve of fulfilment.

But we are concerned, too, with the structure of his mind and body as an implement of research. Passing at thirty-five, he misses, perhaps, the reappraisals inevitable for those who live to later years, entering the shadow of the reflective, and vanishing in the mists of senility. He gathered no rust, was spared the weatherbeating of life. Hartman, and his other zoological associates, appreciate his extraordinary preparation for the culminating discovery of his life. He was not a product of lucky coincidences. His training conformed to the classic scientific pattern. Up to the final illness, his career shows that extraordinary kinetic drive which is a priceless gift in science. Though he died too soon to display to the full the orderliness and grasp of his mind, his indefatigable industry was reinforced by the ability to distinguish almost on the instant between the essential and the non-essential in a problem. He therefore moved with directness upon his objective, wasting neither time nor force on minor issues. The result was a succession of genuine bursts of discovery—a few hours, a few days sufficed to change the whole face of modern medicine, as in the *pallida* work. As one who has had some experience of the difficulties that have confronted post-Schaudinn syphilology, to me the astonishing thing is not alone the prepared mind but the astounding eyesight. Recall that in 1905 no satisfactory darkfield equipment existed. E. Hoffmann had used the Zeiss dark chamber in a search for the organism of syphilis in 1904, without success, and nothing of the sort we know to-day was available until Landsteiner and Mucha demonstrated the organism with the Reichert substage condenser in 1906 (Novy). Schaudinn, a trained microscopist, with a vision superacute through the study of minute organisms in his work on the parasitology of birds, at once saw, in the fresh preparation, what literally dozens of the ablest investigators of the day must have had pass uncomprehended before their eyes. It is a curious commentary on the claims of the great to super-greatness that Bordet and Gengou had, according to Metchnikoff, undoubtedly seen the spirillum of syphilis in a single drop preparation in 1903. They saw nothing in the second preparation, and, as so often happens, the glory passed from them and was gone. It is impossible to escape a thrill of predestination, a sense of the almost intolerably dramatic, in the moment when Schaudinn's mind crossed swords with the problem within the field of the microscopic objective. Something in the universe clicked. What might have been, had he been permitted to go forward to the problems of the life cycle and biologic defense, of symbiosis and pathogenetic mechanism—had he been spared to work with Ehrlich on the chemotherapy—only leaves us with a more tragic sense of loss.

While we yield first place, then, to the undoubted genius, we may draw a little practical guidance from his career. How shall we break the front of an embattled, a seemingly impregnable problem? First, there must be a *man* to whom work is divine, to whom it is meat and drink, rest and play—perhaps even sometimes, as in Schaudinn's fellow Spirochaetenforscher, Noguchi, almost home and love. Such men are few. There must be a fitness of the mind and body to the task. After the man there must come method. He must develop an instrument, a technique with which he attacks his problems This method will perhaps always contain some elements of the intuitive, the esoteric But as rapidly as possible these should be reduced to the objective factual basis which alone makes possible scientific control Into biologic research, dealing with mutable and changing material, plastic to influences often unconsciously exerted, there creeps an unusual element of personal equation, too often overlooked It was said of Noguchi that for a long time an unconscious trick, probably due to his one-handedness, of carrying cultures between incubator and microscope in his vest pocket, of which he was never aware, prevented the confirmation by others of his results in cultivating the *Spirochaeta pallida* I have seen abundant evidence that Warthin has left behind him many unsolved problems in the personal equation of spirochetal staining methods, which even his coworker Starry may have trouble in solving Schaudinn was no desk-man, as his biographers say His published notes and papers reach, however, a total of fifty When he died a rich field lay buried in uncompleted publications and observations referred to only by a word here and there Perhaps it is always so But it illustrates what to me in these complex and crowded days is a desirable, perhaps an essential quality in an investigator He keeps his table, and thereby his mind, mopped up It is all very well to minimize publication, and to rate it for what it too often is, a cheap substitute for work But the devices of honest publication are sufficiently varied now to permit, and in fact require, that the trained man *communicate* as he goes along, rather than to leave a mass of unintelligible and useless notes, or the secondhand impressions of a single assistant to carry on

And lastly, the third essential to the investigator nowadays is persistent singleness of purpose Occasionally genius may still perhaps scatter over the whole field of a science a series of germinal or epochal discoveries Most of us would fare much better, however, and serve more effectively if, like Emil Fischer, we selected our field and perfected one or two tools with which in a lifetime to lay it clean and open, like the well-plowed furrow, to all mankind Thus indeed, it needed in 1905 a zoologist, a parasitologist and a Spirochaetenforscher, rather than a bacteriologist and a medical man, to uncover what many had seen, unknowing.

In a reflective moment after this review of Schaudinn's life, a syphilologist may pause to look back over the directional influence of such a discovery and its fruits A ready comparison or contrast is at hand in the discovery by Neisser of the gonococcus. The two discoveries opened similar roads. It is impossible to escape the belief that the concentration of intellectual forces upon syphilis, as contrasted with gonorrhea, arose to some extent from the intriguing Mephistophelian quality of the one, the sordidly venereal quality of the other Neisser himself lived to advanced years, was throughout his life one of the foremost clinicians of Europe and an organizer of facilities that might well have embraced at least the machinery for the chemotherapeutic conquest of gonorrhea Yet nothing has come of it The discovery of the organism has at least achieved full use in diagnosis Schaudinn was cut off, but by the identification of the organism among the Spirochaetes, he passed the torch, so to speak, to Ehrlich, who had been a student of the chemotherapy of trypanosomiases, near relatives of the spirochaetoses Then flowered forth the whole modern structure of treatment, only for it to be discovered, after a decade or so, that it was, in a sense, a premature blooming The original discovery of Schaudinn has never yet been carried to its logical outcome for practical medicine—the development of easily available, universally applied methods for the recognition of the organism by the everyday doctor or his laboratory deputy Yet how essential such a simplified detection must be to the present-day problem of syphilis is daily reemphasized And curiously enough, yet another epochal development in the syphilologic field has crossed the path of Schaudinn's discovery, to its deferred and even partially defeated usefulness. The Wassermann test, developed with the acclaim and support of the medical profession, overshadowed from the start the early recognition of the organism To-day, to thousands of physicians, syphilis is summed up and described in terms of a positive Wassermann test on the blood How few know it in that far more significant phase for the public health and the ultimate extinction of the infection—the seronegative, dark-field-positive syphilis of the first few days of the primary sore? Yet this is the truly significant syphilis of the future, the one moment that brings the modern chemotherapy to its full possibilities The serologic tests, negative at this most significant moment, by their emphasis on diagnosis in the later stages, important rather for the individual at the moment than for the race in the ultimate, have delayed the perfection of Schaudinn's discovery to its fullest usefulness.

Nothing more clearly presents to my mind the enormous difficulties that beset biologic research and the devastating nature of a loss such as that of Schaudinn than the present status of the *Spirochaeta pallida* as a scientific asset The efforts to develop a virulent organism in culture, the first step to biochemical advance by other than hit-or-miss methods in chemotherapeutic control, has apparently made little headway, in spite of the genius of Noguchi. Twenty-five years after Schaudinn's announcement—a period longer than that which has sufficed to change the whole face of modern physics, for example—and his predictions as to the life cycle, so much needed both for clinical comprehension and treatment research lie almost where they were when he left them. In the recent announcements of Warthin, and of Levaditi, there is little more than Schaudinn foreshadowed in his first communications.

But is there nothing left us but a sense of loss? Before it is too late, perhaps a biographer may provide us with the material for a genuine personality study of the discoverer of the *Spirochaeta pallida*. Then we may know, perhaps, his inward motivations, his possible sense of destiny, if such existed, his foibles, his forebears, his inspired moments, the molders of his personality I regret that I have not been able to lay such a study before you But I can console myself, and perhaps, to some degree, you, too, by asking you to consider in the light of what I have told you, what are the critical essentials of a life. Was his death at thirty-five all tragedy? He escaped all need for debunking, not having lived into the middle period when accumulated responsibility and flagging energies might have demanded first a front and then a mask to conceal a slowly creeping inadequacy. There is something Grecian, Jovian, majestic, in the end. Just as there is much in his work and his discoveries that seems to spring, as Athene, full-blown from the forehead of Zeus, so he vanishes, as she did, in a thunder-clap from the summit of Olympus. But what are the critical essentials of a life, to be measured by deeds rather than by length of days? Surely they lie not in the time or manner of the ending but in the *living*. As I name them, you will know that Schaudinn lived them. They are, to use the utmost talent, to the utmost, for good.

SCIENTIFIC EVENTS

THE UNIVERSITY OF WISCONSIN RESEARCH PATENTS

PATENTS on eleven processes discovered by twelve members of the faculty of the University of Wisconsin are controlled in the public interest and at the same time protected from possible unrestrained exploitation by the Wisconsin Alumni Foundation at the university The peoples of twelve nations in various parts of the world are protected by these patents, which are held at the University of Wisconsin The nations in which they have either been taken out or applied for include the United States, Canada, Great Britain, France, Belgium, Germany, Argentina, Italy, Norway, Sweden, Denmark and Brazil

The foundation is the only one of its kind in existence at any university or college, is an organization through which the results of research at the university are used for the public benefit through corporate channels Established in 1925, its purposes according to its charter are

> To promote, encourage and aid scientific investigations and research at the university and to assist in providing the means and machinery by which the scientific discoveries and inventions of the staff may be developed and patented and the public and commercial uses thereof determined, and by which such utilization may be made of such discoveries and inventions and patent rights as may tend to stimulate and promote and provide funds for further scientific investigation and research within said university

The most recent scientific discovery, for which a patent has been applied for, is the new welding process invented recently by Professor Edward Bennett.

Other processes on which the foundation has patent rights and the names of those responsible for their discovery are Antirachitic activation of medicinal and food products by ultra-violet irradiation, by Professor Harry Steenbock, improvements in process of producing lactic and acetic acids, by Professors E B. Fred and W H Peterson, liquid air freezing of hard-shell seeds, by Mr. W Busse, use of copper and iron salts in anemia, by Professor E B Hart, acetic acid and glucose fermentations of cellulose, by Mr. P. A. Tetrault, apparatus for measuring venous pressure, by Professor J A E Eyster, leavening agent, by Mr E O Wig, mechanic's cleanser, by Professor Farrington Daniels, pituitary hormones, by Professor F. L. Hisaw, and marine paint, by Dr L. C Hurd.

THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

THE great value of microscopic motion pictures to research workers in medicine and biology has been expressed by Dr. Heinz Rosenberger, of the Rockefeller Institute for Medical Research, and others, meeting at Yale University to organize the Biological Photographic Association, the first of its kind. The *New York Herald-Tribune* reports that the organisation was started with thirty-five members, from the United States and Canada, with Dr Ralph P. Creer, director of photography in the School of Medicine of Yale University, as its first president

Speaking on "Micro-cinematography in the Research Laboratory," Dr Rosenberger declared that to-day "all institutions of learning know the value of the motion picture, particularly the [illegible] motion picture, as a means of demonstration. By their domination of time, motion pictures are of enormous help to research workers, since the human eye has its limitations." He described an apparatus set up by the Rockefeller Institute for the study of heart disease, and exhibited one taking motion pictures of human capillaries.

Mr. Herbert Ingram, of Rochester, N. Y., declared that photographic evidence should form the basis for intelligent research and case records. He said further:

> Hospitals should record reliable, accurate case details with supplementary pictorial history. There must be a clinical photograph of the patient, a photograph of diseased tissue, perhaps removed, a photomicrograph of the tissue structure and, in case of cardiac disease, an electrocardiogram.
>
> Photographs of rare skin diseases, intra-abdominal tumors, external glandular malformations, postures and a host of other pathologies provide invaluable data. The diagnosis of disease becomes much simpler by having a visual as well as written record of the progress of a disease.
>
> Many physicians engaged in orthopedic work forget the details of patients who later become involved in medico-legal proceedings. The doctor is at a loss to explain many details of treatment and the progress of injuries without photographic evidence. Motion picture studies of surgical and medical techniques form a newer field than photography and have great possibilities as a teaching medium.
>
> A scientific example of the value of motion pictures would be a photographic study of various gaits, such as ataxia, propulsion and Parkinson's disease. Another possible field is in animal research—to record the results of experiments in diet and in the study of the effects of vaccines.

Dr. Carl D. Clark, director of art and photography at the University of Maryland, was chosen vice-president of the association, and Theodore Nelcey, of the School of Medicine, of Yale University, secretary-treasurer. The directors named are: Dr. Louis Schmidt, of the Rockefeller Institute, Dr. A. B. Soule, of the University of Vermont, and Miss Stella Zimmer, of Syracuse University. The conference ended with an inspection of the Yale University buildings.

THE TULSA MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

THE forty-fourth annual meeting of the Geological Society of America will be held on Tuesday, Wednesday and Thursday, December 29 to 31, at Tulsa, Oklahoma, under the auspices of the Tulsa Geological Society, and on invitation of the American Association of Petroleum Geologists. Headquarters, place of registration and exhibits will be in the Mayo Hotel. The headquarters of the council will also be at the Mayo Hotel, where the scientific sessions will be held. The address of the retiring president, Dr. Alfred C. Lane on "Eutopotropism" will be delivered in the auditorium of the Central High School, on December 29, at 8 o'clock.

Fellows are urged to submit without delay the titles and abstracts of papers which they wish to present at the meeting, so that the program committee may arrange to advantage a program of the sessions. By order of the council, no paper will be considered for the program unless the title is accompanied by an abstract suitable for printing in the proceedings of the society.

All sessions are open to the general public, but the council requests each fellow to send to the secretary as soon as practicable, and not later than December 15, the names and addresses of advanced students or other persons who are seriously interested in geology and are deserving of recognition as visitors. The council will then invite them to attend the meeting.

The affiliated societies which are meeting with the Geological Society of America are:

The Paleontological Society, *secretary*, B. F. Howell, Princeton University, Princeton, N. J.

The Mineralogical Society of America, *secretary*, F. R. Van Horn, Case School of Applied Science, Cleveland, Ohio.

The Society of Economic Geologists, *secretary*, Edward Sampson, Princeton University, Princeton, N. J.

Section E of the American Association for the Advancement of Science will hold meetings in New Orleans, Louisiana, on January 1, 1932, and a joint session with the Geological Society of America is being arranged. On Saturday, January 2, a field trip is planned to the salt domes and salt mines of Teche County.

THE SEVENTH PAN-AMERICAN SCIENTIFIC CONGRESS

THE Seventh Pan-American Scientific Congress will be held in Mexico City from February 5 to 19, 1932.

The program of the congress will be concerned with the physical and mathematical sciences, general and applied geology, engineering; industrial chemistry; biology, scientific agriculture, medicine, hygiene and public health; anthropological and historical sciences, juridical sciences, social and economic sciences, and education.

Members of the congress will include the official representatives of the countries that decide to take part; the representatives of universities, institutions and scientific associations in American countries; the nationals of the countries taking part in the congress and the foreigners residing in them who receive a special invitation from the organizing committee, the authors of papers presented to the congress, all other persons who wish to inscribe themselves and who possess a university degree or who by other ways prove, to the satisfaction of the secretariat general of the Congress, their interest in scientific matters

The organizing committee extends a cordial invitation to all scientists of America to attend the congress and to take part in its labors "The sessions will promote the knowledge of the progress made in the various countries of the continent, in order to study and discuss some of the outstanding problems of those nations and will help to set up closer bonds of lasting friendship between the various countries Mexico awaits enthusiastically the visit of those who will be its guests for a few days, during which both the authorities and the organizing committee will spare no effort to make their stay in the country as agreeable as possible in every way"

Dr Alfonso Pruneda, President of the Organizing Committee, c/o Comision Organizadora del Septimo Congreso Cientifico Americano, Apartado Postal 517, Mexico, D F, will send descriptive pamphlets on request

THE AMERICAN INSTITUTE OF PHYSICS

To meet a generally recognized need for an agency suitably constituted to undertake cooperative projects, the American Physical Society, the Optical Society of America, the Acoustical Society of America and the Society of Rheology have formed the American Institute of Physics This new organization is controlled by the four societies, and certain specific tasks have been outlined for its first efforts It does not have individual memberships at the present time, and its constitution is still in process of development The headquarters office of the institute is at 654 Madison Avenue, New York, N Y.

Three major tasks have been set for the immediate attention of the institute The first and most pressing is concerned with the journals of the four societies, which include *The Physical Review*, *Reviews of Modern Physics*, *Physics*, the *Journal of the Optical Society*, the *Review of Scientific Instruments*, the *Journal of the Acoustical Society*, and the *Journal of Rheology* With perhaps one exception these journals are projects which the societies find increasingly difficult to support And yet they are vitally necessary publications. This situation was brought to the attention of the Chemical Foundation, whose financial assistance in publications of a scientific character is well known In conference it was recommended that a cooperative organization representative, so far as possible, of all physics should be formed at once, and the material help of the Chemical Foundation in such a project was promised

While detailed plans have not been completed for meeting the problem of publication, it is expected that a combination of certain functions will be recommended The business of subscriptions, advertising, printing and mailing, for example, could be carried on in one office for all the journals, probably with increased economy There is, however, no thought of taking over the editorial function That should remain with the individual societies

The second function of the institute is to make contact with the newspapers and news magazines of the country with a twofold object On the one hand, it is desired to help journalists prepare their articles to meet higher standards of accuracy and suitability. On the other, the institute aims to increase the public interest in physics, taking cognizance of the fact that the financial support accorded any human activity is in proportion to the intensity and breadth of interest which it inspires

The four societies which have established the institute realize that there are numerous other groups, national and local in scope, of physicists or those who are interested in physics They wish through the institute to invite the cooperation of these groups in mutual service and in national projects A study of the proper steps to take in this direction is being made as a third function of the institute

A cooperative committee of the four societies has now become the governing board of the American Institute of Physics It consists of three representatives chosen by each society, making a board of twelve in all The initial personnel is as follows.

Physical Society Karl T Compton, chairman of the board, George B Pegram, secretary, John T Tate

Optical Society Paul D Foote, Loyd A Jones, F K. Richtmyer

Acoustical Society H D Arnold, Harvey Fletcher, F. A Saunders

Society of Rheology E C Bingham, Wheeler P. Davey, A Stuart Hunter

It is contemplated that normally each member shall serve three years, a new representative to be elected to replace one retiring each year by each society

At a meeting held at Schenectady in September, the board appointed Dr Henry A Barton, assistant professor of physics at Cornell University, to act as director of the new institute Dr. John T. Tate, professor of physics, University of Minnesota, who is editor of the journals of the Physical Society, was appointed adviser on publications

The first public activity of the new institute consisted of a dinner to journalists held at the New York Athletic Club on November 10. This dinner was very well attended by newspapermen and magazine editors and so laid a basis for the work of the institute as regards public relations Mr Howard W Blakeslee, science editor of the Associated Press, served at toastmaster Dr Karl T Compton, president of Massachusetts Institute of Technology, addressed the guests on the subject of the American Institute of Physics His brother, Dr Arthur H Compton, of the University of Chicago, then spoke on "Recent Developments in Physics in Europe," in particular those concerned with the atomic nucleus

Mr. Waldemar Kaempffert, science editor of *The New York Times*, and Mr Watson Davis, managing editor of Science Service, spoke for the journalists. They welcomed the formation of the institute in very gratifying terms, emphasizing the news value of scientific developments and promising the whole-hearted cooperation of the press

The program concluded with a demonstration by Dr Robert J Van de Graaff of his recently announced electrostatic high voltage generator

SCIENTIFIC NOTES AND NEWS

The Nobel Prize in chemistry for 1931 has been awarded jointly to Dr Frederick Bergius, general director of the I -G Farbenindustrie, Ludwigshafen, and to Professor Karl Bosch, of the University of Heidelberg

Dr John J Abel, professor of pharmacology and experimental therapeutics in the Johns Hopkins University School of Medicine, has announced his intention of retiring from the chair at the end of the present academic year Dr Abel's retirement is the outcome of a desire, on his part, to be relieved of academic duties in order that he may devote his entire time to his own investigations and to editorial work in connection with *The Journal of Pharmacology and Experimental Therapeutics.*

Dr W H Wright, astronomer at the Lick Observatory of the University of California, has been appointed faculty research lecturer for the year 1931–1932 This is the highest honor which the faculty can award to one of its members during the academic year. The lecture will be delivered on the eve of the sixty-fourth anniversary of the founding of the university on March 23, 1932

A dinner in honor of Professor Winterton C Curtis, who has completed thirty years of service in the zoology department at the University of Missouri, was given on November 7 The speakers were Dr F H Woods, Dr Lewis Stadler and President Walter Williams, of the University of Missouri, Colonel Lloyd E Thatcher, of the Branham-Hughes Military Academy, and Father Alphonse M Schwitalla, of St Louis University It was announced that a fund of $2,100 had been raised to establish a graduate scholarship in zoology for summer study at marine laboratories.

Mr. L. A Spindler, of the zoological division of the U. S. Bureau of Animal Industry, was on November 6 the guest of the departments of medical zoology of the School of Hygiene and Public Health at the Johns Hopkins University. As after luncheon speaker Dr. Spindler told of his experiences in the southern United States and later in the day gave a lecture on the life history of the nodule worm *Oesophagostomum longicaudum*

On the occasion of the opening of the new laboratory of physical chemistry at the University of Freiburg im Breisgau on October 30, honorary degrees were conferred on Lord Rutherford, Professor Manne Siegbahn, professor of general physics in the University of Uppsala, and Professor V M Goldschmidt, of Gottingen

An oil painting of the late Dr S Z de Ferranti, an honorary member and past president of the British Institution of Electrical Engineers, has been presented to the institution by Mr H Marryat

Professor Robert DeCourcy Ward, professor of climatology at Harvard University, died on November 12 in his sixty-fourth year

Dr James Simpson Chester Wells, adjunct professor of analytical chemistry at Columbia University from 1905 to 1909, died on October 29 at the age of eighty years

Dr Joseph Kittredge, Jr, senior silviculturist at the Lake Forest Experiment Station of the University of Minnesota, has been appointed professor of forestry at the University of California and forester at the experiment station

Mr. William J Miller, formerly dean of the school of engineering and head of the department of electrical engineering in the Texas Technological College, has been elected head of the electrical engineering department at the University of North Carolina He succeeds Dr Parker H Daggett

At the University of Pennsylvania School of Medicine, Dr. Albert E Roussel, professor of medicine, and Dr. James E Talley, professor of cardiology, have been made professors emeritus

Dr. Leslie T. Gager, clinical associate in medicine at the George Washington University Medical School, has been appointed professor and head of the department of medicine at the Howard University School of Medicine

DR. E T BODENBERG has been appointed assistant professor of biology at Wittenberg College

DR. HOWARD JAMES STOVER, instructor in price and statistics in the department of agricultural economics at the New York State College of Agriculture at Cornell University, has been appointed assistant agricultural economist to the Giannini Foundation of the University of California

DR. J HOLMES MARTIN, of the University of Kentucky, has been appointed managing editor of *Poultry Science*, to succeed Dr L. E Card, who, after serving for eight years, relinquished his office with the November issue of the journal

THE council of the Institution of Chemical Engineers of Great Britain has appointed Mr H W. Cremer to be honorary secretary in succession to the late Professor J. W Hinchley

PROFESSOR KANZAEMON KUKUCHI, head of the department of biology of the Toyama High School, Japan, is studying the collections of oriental invertebrates at the U S National Museum. Dr. Teiichi Kobayashi, of the Geological Institute of the Imperial University, Tokyo, Japan, has also arrived at the museum with a large collection of early Paleozoic fossils.

THE *Museums Journal* reports that Mr Frank H. H Roberts, of the Bureau of American Ethnology, spent the summer conducting a series of excavations in a pit house site south of Allantown, Arizona. Fifteen pit houses were uncovered and specimens of pottery, stone and bone implements, arrow heads, spear points and pendants were obtained.

AT the annual meeting of Delta Omega, the honorary public health society, which was held in the Windsor Hotel on September 14, Dr James A Tobey, of New York, was elected national president, succeeding Dr. John A Ferrell Professor Charles G Hyde, of the University of California, was elected vice-president, and Professor Ira V Hiscock, of the Yale School of Medicine, was reelected as secretary-treasurer Dr Mazyck P Ravenel, of the University of Missouri, was elected as the ninth national honorary member of the society

IT is reported in *Nature* that officers of the Philosophical Society of the University of Durham have been elected as follows *President*, Professor R A. Sampson; *vice-presidents*, Sir Westcott Abell, Professor G. R. Goldsbrough, Professor T. H Havelock, Professor P. J. Heawood, Sir William Marris, Professor J. Irvine Masson; *honorary general secretary*, Mr W. M. Madgin; *honorary treasurer*, Mr. J. W. Bullerwell; *editor*, Professor G W. Todd, and *honorary librarian*, Dr F Bradshaw

THE New York County Medical Society has held its monthly meeting at which officers for the coming year were nominated as follows. *President*, Dr David J. Kaliski, Beth Israel Hospital, *first vice-president*, Dr. Terry M. Townsend, West Side Dispensary, *second vice-president*, Dr Walter T Danpreuther, Postgraduate Hospital, *secretary and director*, Dr Daniel S. Dougherty, Polyclinic Hospital, *assistant secretary*, Dr Peter Irving, Roosevelt Hospital, *treasurer*, Dr. George Kosmak, Women's Hospital, *assistant treasurer*, Dr Ten Eyck Elmendorf Dr Charles Gordon Heyd, president, presided The election will be held next month Two new amendments to the organization's constitution were read They call for the creation of the office of president-elect and a board of five trustees The amendments also will be voted upon at the meeting on November 23

DR ROBERT A MILLIKAN delivered a lecture on recent progress in experimental physics at the Kaiser Wilhelm Institute, Berlin, on November 13

DR EDGAR DOUGLAS ADRIAN, Foulerton research professor of the Royal Society at the University of Cambridge, delivered a lecture at Harvard University Medical School on November 3 on "Sense Organs and Nerve Cells"

AT the meeting of the American Mathematical Society in New York on October 31, Professor D V Widder, of Harvard University, at the request of the program committee, delivered an address entitled "Some Recent Developments in the Theory of Laplace Integrals"

THE seventeenth annual meeting of the American Association of Petroleum Geologists will be held at Oklahoma City on March 24, 25 and 26, 1932, at the Biltmore Hotel. The Oklahoma City Geological Society is arranging entertainment for the meeting. The Society of Economic Paleontologists and Mineralogists, a technical division of the association, will hold a concurrent meeting. Special entertainment and a technical program are being arranged

AN International Mathematical Congress will be held in Zurich, Switzerland, from September 4 to 12, 1932, all nations participating. The president of the committee on organization is Professor R. Fueter, of the University of Zurich.

THE Chemical Foundation has given $10,950 to Columbia University, of which $10,000 is for research in biological chemistry and $950 for research in bacteriology.

DR. E. D. MERRILL, director of the New York

Botanical Garden, has made an agreement with Lingnan University, Canton, China, for cooperative work in the botanical exploration of southern China.

The South Carolina Food Research Laboratory at the State Medical College, Charleston, is in receipt of a grant of $13,000 from Mr Bernard M Baruch, to forward its investigations into the relation of diet to the etiology of simple goiter A considerable portion of the grant will be used in studying seasonal and other variations in the amount of iodine available normally in the environment of people in goitrous and non-goitrous regions. Goiter is not endemic in South Carolina.

The American Mathematical Society has recently concluded two reciprocity agreements with foreign organizations similar to the one now in force between the society and the London Mathematical Society The new agreements are with the Unione Matematica Italiana and the Deutsche Mathematiker-Vereinigung Besides other privileges, members of one of these foreign organizations may become members of the American Mathematical Society on the payment of initiation fee and one half the annual dues, and members of the American Mathematical Society may become members of the foreign organizations on the same terms

Two journals of eugenics have been established recently One, *Genesis*, is published quarterly by the Italian Federation of Eugenics, the other, *Eugenics*, is the monthly organ of the Japanese Eugenics Institute.

The Black Rock Forest Laboratory at Cornwall-on-the-Hudson, New York, has been elected to membership in the International Union of Forest Research Organizations.

The report of the council of the senate of the University of Cambridge on the establishment of a Goldsmiths professorship of metallurgy recommends that the Goldsmiths readership in metallurgy be discontinued and that on the establishment of the professorship the stipend of the professor be £1,200 a year.

A RECOMMENDATION is made by the general board of the University of Cambridge that in the interests of economy and simplification of administration the department of aeronautics should be suppressed and amalgamated with the department of engineering

At a meeting of the Royal College of Physicians of Edinburgh, held on October 14, it was resolved that in view of the national situation, the ceremonies in connection with the celebration of the two hundred and fiftieth anniversary of the foundation of the college be postponed to a future date.

The 69-inch mirror for the Perkins Observatory telescope at Delaware, Ohio, is now undergoing final tests at the factory of Mr J. W Fecker, in Pittsburgh, according to an announcement by Dr Harlan T. Stetson, director of the observatory Invited scientists cooperating in these tests are· Dr J. S Plaskett, director of the Dominion Astrophysical Observatory at Victoria, British Columbia, and Dr. I C. Gardner, of the optical division of the Bureau of Standards An addition to the Mining Laboratories of the University of Toronto, built at a cost of $250,000, was opened on November 7 The principal address was given by the Honorable Charles McCrea, minister of mines for the province of Ontario, which made the appropriation for the building In the evening a number of prominent mining men and former students of Professor H E T Haultain, professor of mining engineering in the University of Toronto since 1908, tendered him a complimentary dinner in honor of the occasion

Dr. Edward R Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, has announced that the institution has accepted from the National Grain Yeast Corporation, Belleville, N. J, a grant for a comprehensive investigation of the chemistry and technology of yeast This research, which will be operated as an industrial fellowship of the institute, will be conducted with the close collaboration of specialists in the donor's organization The results will be made available as the various stages of the studies are completed Dr Roy Irvin, a food and nutritional chemist, has been appointed to the incumbency of the fellowship. He has been a fellow of Mellon Institute since 1917, following the completion of his professional graduate work at the University of Kansas, and has contributed to the literature of bread and baking technology, cereal products and eating habits

Engineering graduates of Cornell University celebrated the sixtieth anniversary of the founding of the College of Engineering on October 17 Tribute was paid to the memory of Hiram Sibley, of Rochester, first president and founder of the Western Union Telegraph Company, through whose gifts the beginnings of the engineering college were made possible. As a part of the celebration the engineering alumni joined in the world-wide observance of the one hundredth anniversary of Faraday's discovery of the principle of electromagnetism. George S. Moler, professor emeritus, reenacted the historic scene when Professor W. A. Anthony and he in 1875 generated electricity with a dynamo they constructed according to Faraday's plans and lighted the Cornell campus while New York and Paris were still using gas illumination.

The assistance which the Citrus Laboratories of the U. S Department of Agriculture have rendered citrus-fruit growers of California and Florida in solving problems of by-product disposal has led to the extension of this work to Texas, following repeated requests for such aid from fruit growers of that state. The last congress appropriated funds for the laboratory which is to be placed on the state-owned land of the Texas State Agricultural Station at Weslaco Total plantings of citrus in Texas amount to approximately 6,650,000 trees, about half of which are now bearing This represents an acreage of about 90,000, with grapefruit accounting for three fourths of the total

THE department of zoology at New Jersey College for Women (the undergraduate woman's college of Rutgers University), New Brunswick, has opened, in its zoology building, a new teaching museum, occupying the room known as the Yardley Memorial Room, in memory of Mrs Margaret Tufts Yardley, first president of the New Jersey State Federation of Women's Clubs, under whose direction the money for the building was raised, and given by the federation to the college for a hall of science The museum, equipped with aluminum-frame cases and glass shelves, houses about half the teaching exhibits of the department of zoology These exhibits are on display to the public, and consist of a series of some 225 mounted birds, representing the species found in New Jersey, together with about 90 skins of birds, both native and exotic, an exhibit of the hawks of the state, so placarded as to bring out their value or detriment to agriculture, a series of skeletons of typical vertebrates and of skeletal parts disarticulated, a series of preserved materials, such as human embryos, embryological series of rat and bird, typical reptilia, vertebrate brain series, human brain, head of an Egyptian mummy (probably predynastic), and miscellaneous material, some 50 anatomical models, both human and infra-human mammal structures, and preserved specimens forming a systematic collection of all phyla of animals, as well as a series of the common invertebrata and smaller vertebrata of the state This last item numbers some 200 exhibits, and is largely divided up among the different laboratories in the building

NATIONAL forest area in Eastern, Southern and Lake States will be increased by the purchase of 16,558 acres of forest land recently approved by the National Forest Reservation Commission, which authorized the expenditure of $52,624 82 for the purpose The commission took recess action in order to advance the date of payment by some six months, as most of the purchases are to be made in areas affected by last year's drought or handicapped by unfavorable financial conditions and unemployment Individual purchases approved will number 166, involving mainly small tracts Prompt payment of cash for these holdings is expected to afford some relief to individual owners and local communities Lands acquired will be added to existing national forest purchase units already protected and administered by the Forest Service for continuous development of forest resources and safeguarding of watershed values More than half the proposed new purchases lie in or are contiguous to the Ozark and Ouachita National Forests in Arkansas, and 1,121 acres are in the Kiamichi forest purchase unit in Oklahoma The Nantahala National Forest in the southern Appalachians will be increased by 1,612 acres About 2,500 acres are to be added to other forests in the South, 389 to the White Mountain National Forest, and 1,858 to purchase units in the Lake States

ACCORDING to the *Journal of Education* the Cuban National University, which has been closed since September, 1930, was reopened this fall under an entirely new plan which will remove it from the direct supervision of the government, according to the proposal of Dr Carlos Miguel de Cespedes, secretary of public instruction, who is working out the details of a proposal to be submitted to Congress The plan is to turn over all buildings and grounds now owned by the state to the university, which will become a separate organization governed by a board of directors composed of twenty-six deans and professors who were appointed to the faculty in 1900 after competitive examinations The government will arrange an endowment of $2,000,000 The matriculation fee will be set at $200 and the government will each year purchase 1,500 scholarships to be distributed among men and women who would be otherwise financially unable to attend the university

DISCUSSION

OESTRUS

A LETTER in SCIENCE of March 27 by Professor S A Asdell, of Cornell, protests the misuse of *oestrum* for *oestrus*, affirming not only that the former, since it can not be a neuter nominative, must necessarily be a masculine accusative and so entirely unjustifiable, and also affirms that Heape introduced *oestrus* into literature as a synonym for animal tumescence. Is he quite correct in either statement? If not too late, may I be permitted briefly to trace the respective histories of the terms?

Oestrus is of course the Latin transliteration of the

Greek masculine noun οἶστρος, oistros (for which the purest Latinists are perhaps wont to employ either *asilus* or *tabanus*), and is therefore itself obviously of the same gender

The Greek word originally referred to a dipterous insect infesting cattle (probably *tabanus bovinus*) the gad- or bot-fly, and in this sense is as old as Homer Later, Aristotle employed it of a parasite of tunny-fish, and also of a small insectivorous bird Meanwhile, by another line of evolution, it came figuratively to signify a sting, hence something that drives one mad, frenzy, insane impulse, mad passion, etc, and is so employed by the writers of the golden period of Greece

So far as I know, its Latin transliteration is first found in Virgil But it is still masculine, as in Pliny

We must now take a leap across the centuries to the learned Isidore of Seville (*c* 600 A D), who, in his "Origines," is apparently the earliest writer to turn this masculine noun into a neuter Why he did so must remain, in the absence of any evidence, inexplicable In any case, his great reputation as a scholar apparently set a precedent for later writers Du Cange, in his monumental "Glossarium Med et Inf Lat," actually spells it oes, but refers to Isidore's *oestrum*

Coming now to English literature, it is a fact that the neuter form has for some centuries been naturalized in our language In 1656, for instance, S Holland, applying the term to a flea, speaks of "defying the eagerness of those sanguine-coated *oestrums*" In 1706, Phillips defines the "*oestrum*, or *oestrus*," as "the gad-bee" Or Badham, in 1854, apparently recalling the zoology of Aristotle, refers to "the conduct of the poor thunny under the scourge of the sea *oestrum*" In 1663, Butler, in the famous "Hudibras," employs the neuter figuratively. "What *oestrum*, what phrenetick mood, makes you thus lavish of your blood?"

Coming still closer to the modern physiological connotation, Jefferson, in 1782 writes as follows "Love is the peculiar *oestrum* of the poet", which to the present writer, at least, suggests the lines from "Locksley Hall",

In the Spring a fuller crimson comes upon the robin's breast.
In the Spring the wanton lapwing gets himself another crest,

In the Spring a livelier iris changes on the burnish'd dove,
In the Spring a young man's fancy lightly turns to thoughts of love

We come now to its definite physiological use. The earliest example that the Philological Society of England gives is dated 1772 (*Ann Reg*) "The times, in which animals of different species feel the *oestrum*, [note that it is neuter and not masculine] by which they are stimulated to the propagation of their respective kinds"

It would seem, therefore, (1) that *oestrum*, as used by modern physiologists, is not intended as a masculine accusative but a neuter nominative (with no philological justification, however, but only that of "the Tradition of the Elders") and (2) that Heape, who wrote in the second half of the nineteenth century, etc, could not have introduced the word (in either its masculine or neuter dress) as applicable to animal tumescence, inasmuch as the last quotation antedates him by practically a century, and also, intrinsically, bears indications of being a record of a connotation already familiar in England

Since writing the above, I find that Isidore was not the first writer to employ the neuter At the close of a discussion of *oestrus*, Facciolatus and Forcellinus, in their "Totius Latinitatis Lexicon," have the following note "Festus facit oestrum neut gen, nam et Graece οἶστρον" The reference is undoubtedly to Sextus Pompeius Festus, the author of twenty books, "de Verborum Significatione" While his date is uncertain, he lived at a later period than Martial (*c* A D 75) and before Macrobius (*c* 400) Isidore perhaps made use of his lexicon, and thus standardized the error

At how early a date there began the trend towards the modern physiological use of the term may be seen from the following citation from IV Macc, a Greek work by a Jewish Alexandrian scholar about A D 50 "For he, a young man at the age when physical desire is strong, by his reason quenched the mad impulse (οἶστρον -masc acc) of his passions. . . The temperate mind is able to conquer the dictates of the passions, and to quench the fires of wild desire (οἰστρῶν)"

Stuart L. Tyson

Pelham Manor, N Y.

POSSIBLE SIGNIFICANCE OF THE DECREASED SUSPENSION STABILITY OF THE BLOOD

The decrease of the suspension stability of the blood, or the increased sedimentation rate of erythrocytes during disease, has provoked an enormous amount of investigation devoted chiefly to employing this phenomenon for diagnosis and prognosis of various illnesses. The fact that red cells settle more rapidly than normally in so great a number of diseases has led many to regard this phenomenon as too general to be of value in diagnosis or prognosis. It is possible that the significance of the reaction has been largely overlooked in the efforts to apply it to practical purposes. It may, as Fahreus has already suggested, play a rôle as a factor in the defense mechanism of the body against infection. Fever easily lessens the suspension stability of the blood by causing an increase in the viscosity of the plasma. As a result there is a change in the electrical charge, the erythrocytes clump and settle rapidly. It has been demonstrated that both erythrocytes and bacteria carry negative charges. The assumption would then be that a decrease of the suspension stability of the blood would also favor clumping of bacteria circulating in the blood stream. If the hypothesis is correct that clumping of bacteria is the first step in the successful disposal of bacteria which gain entrance into the body it would appear that the ease with which the suspension stability is disturbed is of considerable significance. It would be logical to consider fever, which alters suspension stability, as one factor in protection against infection.

A number of experiments recently performed indicate that bacteria of various kinds (pneumococci, Friedländer's bacilli, typhoid bacilli) tend to aggregate and clump in plasma from blood exhibiting a marked decreased suspension stability but not in plasma obtained from a normal individual. The clumping is not striking but can often be observed microscopically. If a weak solution of gum acacia is added to increase the viscosity further, the reaction is markedly enhanced. For instance, acacia was added to one of two parallel series of tubes containing increasing dilutions of typhoid antiserum. Typhoid bacilli agglutinated in a far higher dilution of antiserum in the row of tubes containing the acacia. When typhoid bacilli are added to a 5 per cent. solution of acacia, motility is instantly retarded or stopped. Theobald Smith[1] has recently noted a similar phenomenon in the agglutinating action of agar on bacteria.

A few experiments *in vivo* were performed. Mice were inoculated intraperitoneally with a heavy suspension of type I pneumococci and divided into 3 groups. One group was injected intraperitoneally with 0.5 cc of a 10 per cent. solution of acacia, one group with 0.1 cc of type I antipneumococcus serum and the third group with acacia and antiserum. The mice were killed after ½ hour and 1 hour periods. Pneumococci and leucocytes showed much more clumping in the mice injected with acacia. Occasionally in the mice receiving acacia most of the pneumococci had disappeared, only a few clumps were seen attached to the large agglomerations of leucocytes. In the mice receiving the minute amount of immune serum, pneumococci were found in great numbers, often evenly distributed and not clumped. The observed differences in the three groups were most striking within one hour after inoculation.

It appears, from these experiments, that an increase in the viscosity both *in vitro* and *in vivo* enhances the agglutinative property of specific immune serum. Whether the increase of viscosity of blood plasma which accompanies fever likewise favors agglutination is as yet uncertain and is being investigated.

HOBART A. REIMANN

DEPARTMENT OF MEDICINE,
UNIVERSITY OF MINNESOTA

---

[1] T. Smith, SCIENCE, 74, 21, 1931.

FOSSILS FROM THE EASTERN FLANK OF THE SIERRA NEVADA, CALIFORNIA

THE Sierra Nevada of California has been described as a huge fault block, tilted toward the southwest.[1] The northern end of this mountain mass departs considerably from so simple a form, and consists of several parallel ranges with intervening troughs,[2] but in the central and southern portions, the ideal condition of a simple, though dissected, fault block, seems to be much more nearly realized. The lofty escarpment, which limits the southern half of the Sierra Nevada on the eastern side, is composed mainly of plutonic intrusions, thought to have invaded an older series of igneous and sedimentary rocks in upper Jurassic time.[3] Occasional roof pendants of the older rocks occur along and west of the escarpment, at least as far south as Owens Lake, and farther north, in the vicinity of Mono Lake, they become quite large and abundant.

It would be desirable, both from a scientific and a practical standpoint to determine the age of the older rocks, and to correlate them with similar formations in adjoining regions. Unfortunately, however, fossils, although they have been reported from the western slope of the range, and from the northern portion, by various writers, are extremely rare along the eastern escarpment. Also, the geologic structures in the roof pendants are very complex, because of the intense folding and faulting that probably accompanied the intrusion of the plutonic rocks. The lithologic similarities are of doubtful value.

---

[1] Turner, H. W., "The Rocks of the Sierra Nevada," *U. S. Geol. Survey Fourteenth Annual Rept.*, pt. 2, pp. 435–496, 1894.

[2] Lindgren, Waldemar, and Knowlton, F. H., "The age of the auriferous gravels of the Sierra Nevada, with a report on the flora of Independence Hill," *Jour. Geology*, vol. 4, pp. 881–906, 1896.

[3] Turner, H. W., "The Pleistocene geology of the south central Sierra Nevada with especial reference to the origin of Yosemite Valley," *California Acad. Sci. Proc.*, 3d ser., Geology, vol. 1, pp. 261–321, 1900.

Recognizable organic remains have been found by Walcott[4] in a small, isolated area of lower Cambrian rocks at the base of the Sierra west of Big Pine, in Inyo County, and provisional Triassic forms from the roof pendant at Mineral King have been noted by Turner[5] As yet, no report of fossils from any part of the escarpment between Big Pine and Mono Lake has been seen by the writer. For this reason, it may be of interest to record the recent finding of probable mid-Devonian fossils in crystalline limestone (marble) on the Sierra Nevada escarpment, about 28 miles south of Mono Lake, by Mr W E Selbie, a prospector The writer has spent three summers in geologic field work in this region, part of which was done under the auspices of the California State Division of Mines, and supervised by Dr Olaf P Jenkins, chief geologist. On various occasions during the investigation, Mr Selbie rendered valuable assistance He became interested in the progress of the work, and in the possibility of finding fossils in the older rocks

A few months ago, Mr Selbie sent to the Geology Department at Cornell University, a package containing two fossils, one a large crinoid stem (4 inch in diameter), and the other a small brachiopod These remains are stated by him to have been found in a bed of crystalline limestone, which outcrops on a mountain side a few hundred yards east of Laurel Creek, in southwestern Mono County They were examined at Cornell University by Professor G D Harris, who states that the age of the fossils is uncertain, but they somewhat resemble mid-Devonian forms The brachiopod is thought to be near *Leiorhynchus sp.* (?)

There can be little doubt that the Paleozoic rocks along the escarpment range in age from lower Cambrian to Devonian Whether or not the whole of the Paleozoic section is represented remains uncertain It is hoped that future investigation will yield further data to confirm those now at hand, and to enable further conclusions to be made The finding of more fossils, over a wider area, would not only make it possible to recognize the formations present, but would offer a valuable check on interpretations of geologic structures in the older rocks.

EVANS B MAYO

CORNELL UNIVERSITY

NAMING DISORDERS OF SPEECH

REALIZING the need of a systematic international classification of disorders of speech and voice, the American Society for the Study of Disorders of Speech appointed a nomenclature committee three years ago to prepare such a classification. The committee felt that such a classification should not be published in entirety, however, until accurate definitions of every disorder of speech listed had been approved by at least the leaders in the field of speech correction.

In order to give all workers in this new field of science an opportunity to criticize the best definitions the committee were able to obtain, the committee has just published a tentative "Dictionary of Terms Dealing with Disorders of Speech," and requests those interested to revise every definition which does not adequately describe a given disorder of speech as they have actually known it, and to send the revision to the committee Only so can an accurate revised edition of this dictionary accompany the publication of the final international classification of disorders of speech and of voice

SAMUEL D ROBBINS

SECRETARY AND CHAIRMAN OF
NOMENCLATURE COMMITTEE

A CURIOUS FISH STORY

A QUITE curious case of gastric erosion of a fishhook that had been swallowed by a fish has come under my observation Many experienced fishermen tell me that they have seen nothing quite like it At about eight o'clock in the evening of July 1, Professor C E Hagie, of the History Department of Western State College, hooked a twelve-inch Loch Leven trout while fishing on the Gunnison River When this fish was cleaned it was discovered that it had at some previous time swallowed a No 2 Carlisle bait hook. The barb of this hook had penetrated the wall of the stomach and all of the curvature of the hook to a point on a level with the tip of the barb lay in the body cavity. The straight shank of the hook lay entirely in the stomach Outside of the stomach the hook was in good condition, inside the stomach it had been so eroded by the gastric action that but a mere filament of the former metal was left

An interesting question as to how long it may take for such erosion to be brought about presents itself According to the best opinion that I can get at the hands of expert fishermen of long standing, a twelve-inch trout, in the Gunnison River, takes about three years to reach this size. Trout are put into the river as fingerlings. They grow rapidly and, in a year, according to food conditions, reach a length of about seven inches. In another year they reach a length of from eight to ten inches. The third year they may reach a length of twelve inches.

It would seem certain that the amount of erosion of the fishhook in the stomach of the fish in question would preclude the possibility of its having been swallowed during the present fishing season. This erosion may have been the result of about a year of gastric action It would also seem that such a hook would not have been broken from the leader by a trout only one year old, or one about seven inches in length, unless the fisherman had fastened it very carelessly. A two-year-old trout might possibly do this during the course of a lusty battle with the angler

---

[4] Walcott, C D., "Lower Cambrian Rocks in Eastern California," *Amer. Jour Sci.*, 3d ser., vol. 49, pp. 141–144, 1895.

[5] Turner, H. W., *op. cit.*, p. 451.

C T. HURST

WESTERN STATE COLLEGE OF COLORADO,
GUNNISON, COLORADO

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

NEW ORLEANS MEETING, DECEMBER 28, 1931–JANUARY 2, 1932

EXCURSIONS AND TRANSPORTATION

THE outdoor weather of the mild New Orleans winter will enable delegates and visitors to take full advantage of the interesting trips sponsored by various sections and the general committee at the American Association for the Advancement of Science meeting, December 28 through January 2, according to Dr Daniel S Elliott, chairman of the local committee on preparations

The historic French Quarter or Vieux Carré of New Orleans will receive special attention Most sections, as well as the general committee, are planning to provide delegates with guides for convenient and informal sightseeing tours through this area The Vieux Carré, the site of original white settlement in Louisiana, includes the dimensions of the first town built by the French under Bienville Its museum collection, antique stores and picturesque atmosphere, and architecture cause it to be a Mecca for visitors from all over the world Many buildings date back to the time of French and Spanish occupation Its people, French and Italian, belong to Europe rather than America

Avery Island in New Iberia Parish, the center of Louisiana's extensive salt-mining industry, is the goal set for a special outing sponsored by the geological section Those participating in this excursion will leave New Orleans on the Southern Pacific Railway at 10·40 P M, January 1, traveling in special Pullman cars which will be set out at New Iberia until 7 30 A M, January 2 Immediately after breakfast the party will leave in busses for the interesting localities in that vicinity, under the leadership of members of the local committee for Section E The salt domes and a wild life sanctuary which occupies a portion of the island will be visited on the morning of January 2 Sightseeing will include trips into the mine shafts, which extend several hundred feet underground, giving a view of a wide variety of salt formations

The Association of Commerce of the town of New Iberia is extending its courtesies to visitors After the trip through the mining districts there will be a dinner at a hotel in New Iberia. Returning, the party will leave New Iberia at 3:13 P. M., and arrive in New Orleans at 7 35 P M, January 2 This will give an opportunity to see a salt dome and mine and jungle gardens, as well as many of the interesting features in the "Teche country," the land of Evangeline The total cost for transportation, breakfast and luncheon will be approximately $10 80 for lower berth accommodations and $10 10 for upper berth accommodations Reservation of space in this party should be made directly to Professor R A Steinmayer, Tulane University, New Orleans, La As the party will be limited in number, it is strongly advised that all those who wish to join this party notify Professor Steinmayer at the earliest possible moment

The engineering section will sponsor two excursions dealing with the general subject of flood control and its special application at New Orleans

One afternoon will be given to a short visit to the Mississippi River spillway at Bonnet Carré, twenty-five miles northwest of the city This project, constructed as a result of the flood season of 1927, is designed to divert excess high water from the Mississippi to Lake Pontchartrain, to protect New Orleans.

A tour of the city on another afternoon will take up in detail numerous features of interest to engineers Among these will be the extensive pumping system which is necessary for city drainage, and the reclamation work now in progress along the shore of Lake Pontchartrain

Specific dates and arrangements for these two trips are to be announced a little later through Professor W B Gregory, local representative for the engineering section

Two field excursions are scheduled under the sponsorship of the local committee of the Ecological Society of America One of these is to take place on Thursday, December 31, and the other on Friday, January 1

For each trip the party will leave the St. Charles Hotel in special busses at 9 A M, to return about 5 P. M. The outgoing trip will be via bridges over Pass Chef Menteur and Pass Rigolets The return will be by way of one of the longest bridges in the world, which crosses Lake Pontchartrain for five miles

Representative examples of marsh, bayou and cypress swamp in Orleans and St. Tammany Parishes will be visited.

The trip on Thursday will be attended largely by members of the Ecological Society Friday will be left open for the numbers of interested biologists and others who will probably be occupied with other sessions on the previous day. According to Dr E S Hathaway, of the local committee, it is possible that a half-day excursion may be arranged for the benefit of those who can not take a whole day from other matters

The local group of the Society of American Foresters will sponsor a somewhat detailed inspection of the forest industry at Bogalusa, La, on Thursday, December 31 The party will leave at 8 A M by automobile At Bogalusa they will go through the experimental plant of the U S Forest Service and examine large planted areas maintained by the Great Southern Lumber Company

On these latter lands will be shown examples of natural reproduction of longleaf pine, the effects of different methods of fire protection, the results of yearly burnings and numerous other aspects of practical forestry Of especial interest will be the brown-spot spraying plots, demonstrating preventative measures taken against the brown-spot disease The midday meal will be taken at the Louisiana State University's Forestry School Camp

A tour of points of interest in the New Orleans harbor on the excursion steamer *Capitol* is being promoted by the mathematicians Definite details in regard to this trip will be announced later, according to Dr H E Buchanan, local representative of this section

But the trips formally arranged by various sections represent only a few of the opportunities to be afforded visitors through arrangements for travel singly or in groups which are being worked out by the general committee

By airplane or boat delegates will be able to visit Grand Isle, former rendezvous for the French pirates of the Gulf The trip down the 110 miles of river which lie between New Orleans and the sea will be of interest because of the splendid woodland scenery and glimpses of the primitive life of the inhabitants Waters in this area provide some of the best year-round fishing in the world, while the forests are teeming with wild life—ducks, geese, snipe, doves, rabbits, squirrels, bear, deer—most of which will be in season at the time of the meeting.

Sugar plantations during the interesting season of cane grinding will also be opened to visitors Arrangements have been made with the Godchaux Plantation at Reserve, La., and Southdown Plantation at Houma.

The Evangeline country of the Teche will also attract the visitors. Short trips by bus and automobile to the towns of these French-speaking descendants of Longfellow's Acadians will be possible.

One of the numerous historical sites on the outskirts of New Orleans is the Chalmette battlefield, scene of the battle of New Orleans, in the War of 1812 It is still possible to walk over the very ground on which General Andrew Jackson's motley array of frontiersmen, French pirates, Negroes and Choctaw Indians turned back the tide of British invasion

These journeys are planned to be informative—and to be more—to give delegates a better appreciation of atmosphere and conditions, facts and problems, in a land where French and American civilizations have impacted and fused

The United Fruit Company will offer special post convention trips to Havana, Cuba One itinerary will call for a round trip, New Orleans to Havana and return, while another itinerary will be from New Orleans to Havana and thence to New York Information concerning these trips is as follows

Trip No 1

New Orleans to Havana and return to New Orleans—post convention trip—all expense included plan

Leave New Orleans	ss *Irona*	Jan 2 NOON
Arrive Havana	" "	" 4 A M

(Stop over Hotel Ritz or Bristol—room with private bath and meals included)

Leave Havana	ss *Cartago*	Jan 10— 9 A M
Arrive New Orleans	" "	" 11 P M

(Interesting auto trips, etc, can be arranged in Havana at very moderate cost and will be arranged for those members who desire that such trips be arranged for them)

The fares for the above trip, which also include the hotel stop in Havana with meals, will be

Beds in cabins without private bath on steamer—
$100 00 to $106 00 each person

Beds in cabins with private bath on steamer—
$116 00 each person

Beds in suites with private bath on steamer—
$150 00 each person

Trip No 2

New Orleans to Havana, thence Havana to New York

Leave New Orleans	ss *Irona*	Jan 2 NOON
Arrive Havana	" "	" 4 A M

(Stop over Hotel Ritz or Bristol—room with private bath and meals included)

Leave Havana	ss. *Toloa*	Jan 7 1 A M.
Arrive New York	" "	" 10 A M

(Different auto trips, etc, can be arranged while in Havana at very low cost)

The fares for the above trip, including hotel stay in Havana with meals, will be

Beds in cabins without private bath on steamer—
$135 00 to $143 00 each person

Beds in cabins with private bath on steamer—
$157.00 each person

Beds in suites with private bath on steamer—
$203.00 each person

TRANSPORTATION TO AND FROM NEW ORLEANS

A special section of the Piedmont Limited will leave Boston on Saturday, December 26, at 12 00 noon. This train will be called the American Association for the Advancement of Science Special, and passengers will be limited to scientists and their friends and relatives Eastern members of the executive committee are expected to use this train and to meet for informal discussion of association business. Extra cars are expected to be added at New York, Philadelphia, Washington, Greensboro and Atlanta. An itinerary showing roads, times of departure, etc, follows

December	26	Lv	Boston	NYNH&H	12 00 NOON
"	"	Lv	New Haven	"	3 35 P M
"	"	Ar	Washington	PRR	10 05 P M
December	26	Lv	New York	PRR	6 45 P M
"	"	Lv	Trenton	"	8 03 P M
"	"	Lv	W Phila	"	8 44 P M
"	"	Lv	Baltimore	"	10 43 P M
"	"	Ar	Washington	"	11 38 P M
December	26	Lv	Washington	Sou Rwy	11 55 P M
"	27	Lv	Charlottesville	"	2 55 A M
"	"	Lv	Greensboro	"	7 30 A M
"	"	Ar	Atlanta	"	4 00 P M
"	28	Ar	New Orleans	L&N	7 20 A M

It is hoped that western and central railroads will also arrange for special trains

For many of those planning to attend the New Orleans meeting of the association, from December 28, 1931, to January 2, 1932, there will be a choice of two kinds of reduced railway fares (1) on the standard certificate form and (2) short limit round trip winter excursion fares

(1) Reduced railway rates, by the standard certificate plan, have been granted by all the railway passenger associations in the United States and by the eastern lines of the Canadian Passenger Association, but a few companies, listed below, have not granted reduced rates. The round-trip fare by this plan is one and one-half times the regular one-way fare.

Tickets to New Orleans by the standard certificate plan are to be purchased within time limits as follows. December 21 to 27, inclusive, for Canadian Eastern lines, Central lines and Trunk lines For New England lines, December 20 to 26, inclusive. For Southeastern lines, December 22 to 28, inclusive. For Western and Transcontinental lines the inclusive dates are December 18 to 24 from California, December 19 to 25, from Arizona, British Columbia, Idaho, Montana, Nevada, Utah, Washington and Oregon (except *via* California), December 17 to 24 from Oregon (*via* California), December 20 to 26 from New Mexico, Wyoming and Colorado (except Julesburg); December 21 to 27 from Julesburg, Colorado, and from Illinois, Iowa, Kansas, Manitoba, Minnesota, Missouri, Nebraska, northern Michigan, North Dakota, South Dakota and Wisconsin. For the Southwestern lines the inclusive dates are December 20 to 26 from Oklahoma and Texas and December 21 to 27 from Arkansas, Kansas, Louisiana and Missouri; also Memphis, Tenn, and Natchez, Miss.

The following Southwestern lines do not offer reduced fares on the certificate plan. Arkansas and Louisiana Missouri Railway, Fort Smith and Western Railroad, Graysonia, Nashville and Ashdown Railroad, Missouri and North Arkansas Railway, Oklahoma City-Ada-Atoka Railway, Wichita Falls and Southern Railway, Kansas, Oklahoma and Gulf Railway, National Railways of Mexico and the Midland Valley Railway

Persons residing in the regions of reduced rates (almost all the United States and Canada) should each purchase a first-class, full-fare, one way, through ticket to New Orleans, being sure to secure a certificate on "Standard Certificate Form," reading for the "New Orleans meeting of the American Association for the Advancement of Science and Associated Societies" A receipt is not required and will not be useful

Persons residing outside the regions of reduced rates should each purchase a round-trip ticket to the nearest station issuing through tickets to New Orleans and situated within the region of reduced rates. On arrival at that station a one-way ticket to New Orleans and a certificate, as directed in the preceding paragraph, should be secured

Every one should register immediately upon arrival at New Orleans, at the registration offices for the meeting, in the Roosevelt Hotel. Be sure to fill in all blanks on the registration card and leave the card at the registration desk, where you will receive a numbered identification card, which will be receipted for the registration fee paid. (See Registration, below.) Then leave your railway certificate at the validation desk, being sure that the identification card (which you keep) is there marked to show that you have deposited a certificate. Your certificate will subsequently be endorsed by the association and then validated by the agent of the transportation companies Call for it later at the validation desk, where you left it, presenting your identification card.

Unvalidated certificates will not be honored for the purchase of return tickets and unendorsed certificates can not be validated Registration is therefore necessary in order to have a railway certificate validated. Each person registering is entitled to the validation of his own certificate.

For the return trip, railway agents at New Orleans will honor any properly endorsed and validated certificate if presented at least thirty minutes before the scheduled time of departure of the train for which it is to be used. Each person presenting an endorsed and validated certificate may purchase a continuous-passage, one-way, return ticket for one half of the regular fare, by the same route as that followed on the trip to New Orleans. Certificates may be validated from December 28, 1931, to January 1, 1932. The last date on which return tickets may be purchased is January 5.

(2) Short limit round-trip winter excursion rates are available from many points in the United States to destinations in Alabama, Florida, Louisiana and Mississippi, and also to Havana, Cuba. These rates have been granted for only certain days in November and December, 1931, and March and April, 1932. During December, 1931, round-trip excursion tickets to New Orleans may be purchased on the following days: 4, 5, 8, 11, 12, 13, 18, 19, 20, 25, 26 and 27. Tickets are limited to 16 days, including date of purchase and actual time required to return to starting-point. The following is a comparison of the cost under the two plans of a round-trip ticket (not including Pullman berth) from Washington, D. C., to New Orleans:

Standard Certificate form (one and one half fares)	$60.30
Short limit round-trip winter tourist rate	54.30

It is advisable to get information from your local ticket agent about the excursion fares, since there are some points where they are not available. The Canadian eastern lines and the Transcontinental lines are among those that are not authorizing these fares.

CHARLES F. ROOS,
Permanent Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF SUPPLYING STUDENTS WITH NATURAL ENDAMOEBA HISTOLYTICA FROM CULTURES[1]

INSTRUCTORS in protozoology are not always fortunate enough to have an active case of amoebic dysentery available for use in the classroom. Cultures of *Endamoeba histolytica* are commonly used, but the amoebae in culture are much smaller[2] than those encountered in the amoebic stool. It would seem desirable to be able at any time to supply large amoebae and these should also contain red blood cells.

In the course of some experimental studies, irrelevant to the present subject, it was found that the addition of gum arabic to produce a 0.1 per cent solution in the liquid portion of the ordinary Boeck and Drbohlav medium[3] resulted in a marked increase in the size and number of the amoebae usually present. Further investigation disclosed that the increase in size was probably related to the bacteriostatic action of the gum arabic. As a matter of fact some of the bacteria commonly found in association with the amoebae in culture were not only inhibited but were killed by the use of gum arabic in stronger percentages. The increase in size of the amoebae led one competent observer to remark; "That is the nearest thing to *histolytica* in the stool I have ever noted in cultures."[4] The amoebae, although increased in size, are somewhat slowed in action by the increased viscosity of the fluid.

Usually the addition of red blood cells to cultures of *Endamoeba histolytica* results in the hemolysis of the cells very quickly, with the result that if the cells are ingested only shadows of the cells can be seen within the amoeba. Furthermore, the amoebae, in my experience, seldom ingest the red blood cells under these conditions. In the course of certain immunological studies involving the amoebae, it was found that successful efforts to cause them to ingest red blood cells resulted from the use of the following technique:

Mix the medium well by rotating the culture tubes between the palms of the hands. Combine the liquid portion of ten cultures so treated, place in 10 cc centrifuge tubes and centrifuge at 1,000 r.p.m. for ten minutes. Discard the supernatant liquid, combine the sediment, and add two to five cc of rabbit serum. Mix well with a pipette and add 0.1 cc of guinea-pig or rabbit red blood cells. The latter are obtained by defibrination and centrifugalization. Again centrifuge at 1,000 r.p.m. for ten minutes and place in the water bath for two hours. At the end of this period many of the amoebae will be found to have ingested the cells; some will contain a large number, twenty or more cells may be found within them. The preparations made from sediment were found to be satisfactory up to at least six hours, after this time the cells begin to hemolyse and the amoebae to disappear.

Enlarged amoebae containing red blood cells, resulting from the technique described, yield very pretty specimens for class work and give students a better idea of *Endamoeba histolytica,* as found in infections, than is conveyed by the use of ordinary cultures of this parasite.

---

[1] From the laboratories of the Army Medical School, Washington, D. C.

[2] J. H. St. John, American Journal of Tropical Medicine, 6, 319, 1926.

[3] W. C. Boeck and J. Drbohlav, *Proc. Natl. Acad. Sci.*, no. 5, Washington, 1925; *Amer. Jour. Trop. Hyg.*, 5, 371.

[4] Colonel Charles F. Craig, Medical Corps, U. S. Army.

J H ST JOHN

ARMY MEDICAL SCHOOL,
WASHINGTON, D C

PHOTOGRAPHING ANIMALS

THE scientific photographer often has trouble getting animals in a suitable position Small animals are very active and will not stay long enough in a pose to be photographed successfully We tried out a method for quieting snakes and lizards and it gave good results

The photographs were made at night with Eastman flash paper, and the animals remained still in spite of the flash. The animal to be photographed was placed under an inverted box for a minute or two until all signs of commotion had ceased. The box was lifted quickly but smoothly, the flash-paper was ignited and the film was exposed This method was also tried in broad daylight with lizards, snakes and rats, and gave good results with all the animals tried This simple method may be good when the animal has to be moved to certain surroundings and resents it Evidently the swift change from total darkness to a sudden glare leaves the animal dazed for a moment and gives time for the exposure.

ARTHUR L KAHN
GEO H HANLEY

SPECIAL ARTICLES

ACCELERATED INFECTION IN EXPERIMENTAL POLIOMYELITIS

THE 1931 epidemic of poliomyelitis will enable investigators to study by experimental means, in monkeys, many aspects of the disease, as well as the virus inducing it The establishment of strains of the human virus in monkeys is attended by initial difficulties which it is desirable to overcome. The experience of the past indicates that a proportion only of human strains can be implanted on the monkey *Macacus rhesus* is the species which has been commonly employed for inoculation It has not infrequently happened that after the first successful inoculation of monkeys with human spinal cord or medulla obtained from fatal cases of poliomyelitis, the succeeding inoculation of the spinal cord of the affected monkey has failed to induce disease The reason for this disparity is not known. It is supposed that degeneration or virus metabolic products contained in the human cord act to make the originally inoculated monkey more susceptible to infection

A way has been found to increase the proportion of successful inoculations of affected human and monkey spinal cords and brain stems A number of years ago, Amoss and I observed that an attenuated strain of the monkey virus, unsuccessful on first inoculation, could be made to induce infection by repetition of the injection We have recently employed this method in implanting 1931 human strains of virus on *Macacus rhesus* monkeys The method consists in injecting intracerebrally and intraperitoneally, under ether anesthesia, 10 per cent suspensions of glycerolated spinal cord. The suspensions should be free from bacteria as shown by aerobic plate tests In our experience thus far, symptoms have either not appeared at all in from 7 to 10 days, or initial symptoms, slight in degree, have arisen and have failed to progress or have disappeared The effects, if any occurred, tended therefore to the production of the abortive form of experimental poliomyelitis

Time was allowed to elapse in order to determine whether the symptoms would progress or recede As no increase occurred, reinoculation was resorted to with material from the same subjects as was employed for the original injection Again the double—intracerebral and intraperitoneal—inoculations were made, using of course the opposite side of the brain The symptoms which were stationary or receding were rapidly augmented, and about three days after the second injection the symptoms became pronounced, progressing quickly to paralysis and prostration, as is the rule with infected monkeys

Not only can the abortive be converted into the progressive paralytic disease by means of reinoculation, but monkeys which develop no detectable symptoms in 11 or 12 days have been successfully infected through the employment of a second injection The critical period seems to be about three days after the second injection. Within this brief period an accelerated reaction occurs. Whether the acceleration is due to virus alone, or in part to the alien (human) tissue elements, is not known. It may be merely a summation of virus effects, such as Amoss and I observed with monkey strains of virus The results as described are not invariable In one or two instances the accelerated effect either failed to arise or was delayed

The tests to determine whether the reinoculation method suffices to establish durably in monkeys many strains of human poliomyelitis virus have yet to be completed It remains also to be seen whether highly potent virus strains adapted to monkeys can be readily secured in this manner

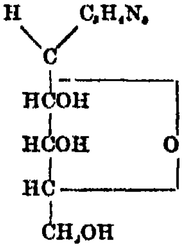
The histological changes present in the spinal cord and the basal and intervertebral ganglia of the reinoculated animals are typical of experimental poliomyelitis

Simon Flexner

The Rockefeller Institute for
Medical Research,
New York, N Y.

THE RING STRUCTURE OF ADENOSINE

Adenosine is an adenine glycoside of d-ribose As in the case of other glycosides, this particular one may exist in two forms isomeric with regard to their *ring structure*


I

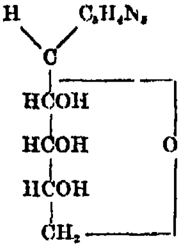

II

Fig I represents the furanoside and Fig II the pyranoside structure It has now been established that natural adenosine possesses the furanoside structure. This information is important in connection with the theory of the structure of nucleic acids, of which a detailed discussion will be given elsewhere

The structure was established through the complete methylation of the nucleoside By hydrolysis of the methylated nucleoside a trimethyl ribose differing from 2, 3, 4-trimethyl ribose has been obtained and to the new sugar is attributed the furanose structure The points of difference are

(1) The physical state at room temperature, the substance from the nucleoside being a liquid whereas 2, 3, 4-trimethyl ribose is crystalline

(2) The optical rotation, that of the new substance being $[\alpha]_D^{26} = +51.6°$ and that of the corresponding pyranose $[\alpha]_D^{27} = -51.7°$.

P A Levene
R Stuart Tipson

The Rockefeller Institute for
Medical Research,
New York, N Y

ALARIA MUSTELAE SP. NOV., A TREMATODE REQUIRING FOUR HOSTS

An undescribed trematode of the superfamily, Strigeoidea, occurring in the intestines of wild minks and weasels of Michigan, is of particular interest because it requires four hosts for the completion of its life history and its hermaphroditic adult stage is preceded by a series of three larval stages, cercaria, agamodistomum and metacercaria.

The cercaria resembles in many respects *Cercaria marcianae* Cort and Brooks, 1928, but differs from the latter in its smaller size, its simpler excretory system which consists of five flame cells in the body and two in the tail stem on each side, the spination which is restricted to the anterior portion of the body, the possession of only a single row of spines around the opening of the acetabulum, and by the position of the four penetration glands, two on either side of the ventral sucker The further development of the cercaria is much like that of *C marcianae* for it also penetrates frogs and tadpoles, in which it undergoes some growth and development It also retains many of its cercarial characters after entering its first vertebrate host so that it is similar to *Agamodistomum marcianae* from which it can be distinguished, however, by the same characters which differentiate the cercariae of the two species When these agamodistomes were fed to laboratory raised rats and mice, they underwent further growth and development becoming fully developed metacercariae of the diplostomulum type in the muscles. Similar metacercariae were found as natural infections in the muscles and lungs of the mink and raccoon, and in the muscles of the white-footed deer-mouse

Experimentally infected laboratory mice were fed to a parasite-free ferret, and ten days later full grown Alaria were found in the intestines Metacercariae from lungs of minks when fed to dogs, cats and ferrets also developed into Alaria The worms raised experimentally in all these hosts agree in all characters including measurements with those found in the intestines of wild weasels and minks

Experiments to get cercariae to penetrate directly into mice were unsuccessful, proving that the stage occurring in frogs and tadpoles is an essential step in the life cycle of this parasite *Alaria mustelae*
passes through the following stages and hosts in ...rious
to complete its life history, sporocysts in ...g, from
producing cercariae, which penetrate into ; by adding
frogs in which they become agamodistomincreasing the
eaten by a mammal, such as a mink, rac by adding a
become metacercariae in the muscles substance. It is
cercariae grow to adult state when organism being
mammal such as a mink, weasel, quirement for, say
in the intestines of which they or synthetic humic
From the latter, miracidia hatchity might very well
of infecting the snail. num, instead of, or in

Many metacercariae in all we are aware, no com-
were secured from lungs of min in favor of any of
to follow the development
system and the reproduct contained in humic acid
ies besides growth. Many

excretory system arises as an outgrowth from the primary excretory bladder, the branches of which secondarily anastomose to form the network of vessels and spaces characteristic of the adults of the superfamily Strigeoidea All the organs of the reproductive system are completely formed in the metacercaria but in a less mature state than in the adult.

Alaria mustelae, sp nov characters of the genus Length 0 82–1 74 mm, foliaceous forebody one to two times length of the cylindrical hindbody, entirely covered with retrorse spines Oral sucker terminal, average width and length 0 082 x 0 082 mm, slightly larger than acetabulum, but shorter than pharynx, which averages 0 106 x 0 078 mm, ovary anterior to testes, averaging 0 152 mm in width, Mehlis' gland postero-lateral to anterior testis, uterine eggs few, averaging 0 11 x 0 072 mm Cercaria fork-tailed, pharyngeate, flame cell pattern 2[(1+1+1)+(1+1+(2))], developing in slender unbranched sporocysts in the snail, *Planorbula armigera* Agamodistomum stage in frogs and tadpoles Metacercariae of diplostomulum type, in muscles and lungs of small frog-eating mammals

Poche, 1925, split up the family Strigeidae Railliet, separating off the family *Cyathocotylidae* with *Cyathocotyle* Muhling as the type genus It is here proposed to restrict the family Strigeidae still further by removing all those forms not belonging within the subfamily *Strigeinae* Railliet. The genus *Braunina* Heider becomes the type of the family *Brauninidae* fam nov, which is characterized by the great reduction of the hindbody, by the inclusion within the holdfast organ of all reproductive organs except terminal portions of genital ducts, and the possession of cirrus and cirrus-pouch The genus *Alaria* Schrank is the type of the family *Alariidae* Tubangui, 1922, which includes the subfamilies *Alariinae* Hall and Wigdor, and *Polycotylinae* Monticelli The genus
Cleistogamia Faust is removed from the superfamily
succes*oidea* since it does not have a holdfast organ,
spinal con sses several characters not found within the
ago, Amoss a *Strigeoidea* These characters are those
of the monkey ich make the cleistogamous type of fer-
could be made t rative and the nonoperculate egg with
injection We h pendages The genus Cleistogamia
implanting 1931 h n a new family *Cleistogamiidae* with
rhesus monkeys T y *Cleistogamiinae* Faust, 1927 No
tracerebrally and im ed regarding its relationship to
thesia, 10 per cent su
cord The suspensions lescription of this parasite, its
as shown by aerobic pl ussion of the taxonomy of the
thus far, symptoms have elsewhere.
in from 7 to 10 days, or
degree, have arisen and h

Nelly J Bosma

THE RELATION BETWEEN IRON, HUMIC ACID AND ORGANIC MATTER IN THE NUTRITION AND STIMULATION OF PLANT GROWTH

This communication will report briefly an extensive investigation just concluded in which the chemical substance contained in natural soil humic acid, chiefly responsible for the marked stimulation of growth of various higher and lower plants, has been determined The growth studies have been conducted with the free-living aerobic soil bacterium *Azotobacter vinelandii*, and, although the findings apply strictly to this organism only, there are numerous reasons for believing them to apply quite generally to other organisms, in qualitative respects, at least A wide variety of experimental conditions have been employed with respect to method of growth, criteria of growth and stimulation, nature of medium, source and concentration of nitrogen, temperature, pH, duration of experiment and humic acid The results are being described in detail elsewhere,[1] but in view of their general implications and interest are being summarized here

Both natural soil humic acids and synthetic humic acids have been employed The former were prepared by washing soil with N HCl and then extracting with 10 per cent KOH, the latter by boiling 20 per cent glucose in 35 per cent HCl and then centrifuging and extracting with 10 per cent KOH Purification was accomplished in both cases by precipitating at pH 3, centrifuging, and redissolving at pH 7 5, the cycle being repeated five times in all It was possible to prepare, by minor variations in method and soil used, natural humic acids varying in iron content from 0 06 to 1 4 per cent By adding $Fe_2(SO_4)_3$ to the glucose-HCl mixture during boiling, it was possible to prepare synthetic humic acids varying in iron content from 0 03 to 4 4 per cent, other metals could be introduced similarly into the synthetic humic acids.

It has been determined that natural humic acid increases growth primarily, if not entirely, by virtue of the *iron* it contains, the organic fraction is substantially inactive, and likewise other inorganic impurities. The following evidence supports this finding.

(a) Natural humic acid may be substituted more or less satisfactorily by complex non-ionized iron combined with an organic acid, such as ferric citrate, tartrate, oxalate, by inorganic ionic iron such as ferric sulfate, metallic iron; and by synthetic humic acids containing considerable percentages of iron In any given experiment there may be a certain variability in response to the four different iron types, depending upon the particular nature of the experiment, and inevitable secondary differences between the types A statistical study of the mass of data available shows, however, that *a given amount of soluble iron gives the same order of stimulation independently of whether the iron is added as in natural humic acid or as in any of its substitution compounds* This statement is made with the provision that the experiments be allowed to proceed long enough to permit complete physiological consumption of the iron added, so as to avoid any limitation through induction period differences as described below Iron stimulation may be observed often upon addition of as little as 0 01 p p m. Fe The minimum concentration yielding approximately optimum stimulation, however, is about 0 5 p p m, under conditions where significant decreases in the iron concentrations being studied do not occur during the period of measurement As the iron is later consumed in growth, as a function of time, the minimum optimum concentration of initially added iron may shift to as high as 5 to 10 to 15 p p m, causing 5 to 20-fold increases in growth As a corollary to these quantitative relations, it may be stated that, as the percentage of iron contained in a compound increases, so stimulation increases, for any given concentration of natural or synthetic humic acid, or organic acid, iron compound In considering inorganic iron it is important to observe that, although the last three types of compounds are completely soluble, inorganic iron is soluble in the majority of neutral media to the extent of only 0 01 to 0 05 p p m., which is considerably below the minimum optimum concentration of about 0 5 p p m Owing to this solubility limitation inorganic iron will often yield, especially in experiments of relatively short duration, less satisfactory stimulation than the other three types, when comparison is made upon the basis, not of soluble iron, but of total iron added to the medium

---

[1] "The Chemical Nature of Humic Acid Growth Stimulation in Relation to Iron" and "The Physiological Nature of Humic Acid Stimulation of *Azotobacter* Growth," submitted for publication to *Soil Science*. These papers contain some seventy-five tables and figures of experimental data and represent several thousand experimental cultures The relation of the present investigation to previous similar ones will not be discussed here, beyond mentioning the following recent pertinent papers. Clark, Science, 71, 269 (1930); Hopkins, *Bot. Gaz*, 89, 209 (1930), Olsen, Compt. rend. Lab. Carlsberg, 18, 1 (1930); Iwasaki, *Bioch. Zeit.*, 226, 32 (1930); Blumenberg and Blumenberg, U. S. Patent 1,782,694, Dec. 2 (1930); Farries and Bell, *Ann. Bot.*, 44, 424 (1930); and Ashby, *Ann. Bot.*, 43, 805 (1929).

(b) Natural humic acid was not substituted by humic acids prepared synthetically from glucose to contain no more than traces of iron; by iron-free synthetic [illegible] acids containing various metals such as [illegible]n able to s Si, Mo and P; or by salts of such ele[illegible]l funds to Co, Mn, Mo, Ni, Zn, Cr, Cu and Ag, at va[illegible]ators, screens tions ranging from 0 01 to 50 p p m [illegible]lants, printin al humic acid and all compounds cap[illegible] places, a tuting for it show an induction per[illegible]mmittee T in terms of hours, before stimulation

(d) Humic acid does not act by increasing directly the availability of constituents normally added to, or present in, the medium, *viz*, glucose, oxygen, free or fixed nitrogen, carbon dioxide, Ca, Mg, Na, K, Fe, PO_4, Cl, SO_4, HCO_3, or by deactivating toxic metabolic products, or by affecting the surface tension, viscosity, potential differences between culture medium and organism, or oxidation-reduction potential of the medium

(e) Under conditions where humic acid exerted no stimulative effect the iron substitution compounds likewise exerted no effect, even though other chemical substances and physiological conditions could at the same time increase the growth considerably

The only observed inherent difference between various types of iron compounds obtains with respect to the physiological induction period. In the case of *Azotobacter,* natural and synthetic humic acids ordinarily commence to exert stimulation 3 to 8 hours after addition, organic acid iron compounds after 8 to 15 hours, and inorganic iron compounds after 15 to 30 hours Natural and synthetic humic acids are to be classed, therefore, as stimulants which provide iron for growth and nutrition in a form *more highly available* than that generally supplied in media They are more highly available than organic acid iron compounds by virtue of induction period differences, than inorganic iron by virtue of both induction period differences and solubility relations They may also be classed as nutrients, since, as pointed out above, when time is not a limiting factor, the same quantitative order of stimulation is obtained independently of iron compound type Humic acids are not plant vitamins or any other constituents classifiable as essential to growth or nutrition, since they may be replaced by other substances containing iron

It is realized that various humic acids, prepared from various soils or sugars and metals under various conditions might, contrary to our findings with *Azotobacter,* occasionally exert stimulation from various causes in addition to that of contained iron, *e g*, from contained aluminum, silica, phosphate, etc., by adding a protective agent against poisons, by increasing the availability of medium constituents, or by adding a specific, stimulating, purely organic substance. It is conceivable, for instance, that some organism being studied might possess a special requirement for, say aluminum, in which case a natural or synthetic humic acid containing aluminum impurity might very well act by virtue of supplying aluminum, instead of, or in addition to, iron. So far as we are aware, no comprehensive, critical data obtain in favor of any of these suggested causes.

On the other hand, iron contained in humic acid may promote other processes besides growth. Many biological processes, such as respiration, nitrification, catalase activity, etc, probably require iron We have recently determined that apart from its essential function in both the growth and respiration of *Azotobacter*, iron is also essential in the chemical mechanism of nitrogen fixation by this organism Under certain conditions of relative iron starvation, natural or synthetic iron-containing humic acids may supply this iron, replacing the more customarily supplied inorganic or organic iron compounds In this sense the humic acids may be said to influence directly the mechanism of fixation Under ordinary conditions, humic acids have no such direct influence, but exert the same quantitative stimulation whether the organisms are grown in free or in various forms of fixed nitrogen

In conclusion, a few of the implications of these findings, apart from their relation to respiration, growth, and nitrogen fixation by *Azotobacter*, may be mentioned There are undoubtedly fifty or more different plant and animal growth stimulators described in the literature, such as bios, yeast water, plant extracts of various kinds, organic extracts, peat extracts, soil extracts, auximones, egg albumen, egg extract, Rhizopin, vitamin B and possibly other vitamins, in which the chemical reason for stimulation is in practically no case known Humic acid is thus probably one of the few growth promoters of which the chemical constitution of the active constituent has been definitely determined It is possible that many, perhaps the majority, of the promoters consist substantially of iron bound in an organic, highly available form, since their action appears to be very similar to that of humic acid, indeed, it may be suggested that the real problem in connection with the chemical nature of the active fraction of these promoters would perhaps more often be to show that they do *not* function chiefly because of contained iron Many media, *viz.*, legume nodule bacteria media, stock culture media, are made up to contain yeast water, plant extracts, egg extract, or bios, of complicated and relatively unknown general composition, the use of humic acids, particularly synthetic ones, would perhaps often provide desirable substitutes in some degree avoiding this objectionable feature It is probable, for instance, that the recent yeast-growth stimulant prepared by Fulmer, Williams, and Werkman[2] in the sterilization of synthetic yeast medium at elevated temperatures is similar to our synthetic humic acids, the iron being derived from the probable 1 p p m. iron impurity contained in the 5 per cent sucrose employed

It is possible that iron added as humic acid to water cultures of higher green plants would upon occasion be superior to most of the forms of iron now employed, especially in the matter of requiring much less frequent addition. Whereas inorganic iron compounds tend in general to precipitate as the pH is increased, the converse obtains with respect to humic acid, above pH 4 Even compounds like ferric citrate precipitate in neutral solutions, upon long standing, whereas properly prepared humic acids remain soluble indefinitely Many higher plants grown in water cultures must be maintained under relatively acid conditions, in order to derive sufficient iron from the forms usually supplied, the use of humic acid might permit satisfactory or improved growth under substantially neutral or alkaline conditions.

The nutritional value of humus and soil organic matter in agricultural cropping is recognized generally, being ascribed, however, chiefly to indirect effects upon soil moisture, texture, aeration, etc How far the nutritional value is directly referable to rendering iron more available, particularly in soils in which the inorganic iron solubility is low, is an important problem of agricultural science which would appear to be in some measure enlarged by the present investigations It is our hope, in view of the fact that the latter have been concerned solely with *Azotobacter*, that the general problem of the influence of natural and synthetic humic acids upon the growth and nutrition of higher plants under field and water culture conditions will receive the attention of plant physiologists equipped to deal with the question

Dean Burk
Hans Lineweaver
C Kenneth Horn
F E Allison

Fertilizer and Fixed Nitrogen Investigations Unit, Bureau of Chemistry and Soils, United States Department of Agriculture,
Washington, D C.

BOOKS RECEIVED

British Museum of Natural History *Guide to the Exhibition Galleries* Pp. x + 249 Illustrated 1s. *Short History of Collections* Pp xi + 62 6d *Guide to Exhibition Illustrating the Early History of Paleontology* Pp vi + 68 Illustrated. 9d The Museum

Dominguez, C V. *Investigation on Impure Spectra and its Consequences for the Theory of Colours* Pp 40. Illustrated Ruiz Hnos, Buenos Aires

Grant, U S, IV and Hoyt, R. Gale. *Cat*[illegible] *of the Marine and Pleistocene Mollusca of C*[illegible] *Adjacent Regions* Pp 1036 32 plat[illegible] Society of Natural History $8 00

Peake, Harold and Herbert J F[illegible] *Venturers in Bronze* Pp vii[illegible] Yale University Press $2 00

Stockdale, Paris B *The Border*[illegible] *of Southern Indiana* Pp xi + 3[illegible] plates Department of Conservati[illegible]

---

[2] *J. Bact.*, 21, 299, 1931

SPECIAL ISSUE CONTAINING THE PRELIMINARY ANNOUNCEMENT OF THE SECOND NEW ORLEANS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES, DECEMBER 28, 1931, TO JANUARY 2, 1932. EDITED BY DR. CHARLES F ROOS, PERMANENT SECRETARY

SCIENCE

VOL 74 FRIDAY, NOVEMBER 27, 1931 No 1926

The American Association for the Advancement of Science
Preliminary Announcement of the Second New Orleans Meeting DR CHARLES F ROOS 525
Important Notices for those Planning to Attend 527
The American Association Press Service 527
The American Association Prize 528
Scientific Sessions of Sections and Societies 528
General Officers of the Association for the Calendar Year 1931 536
Obituary
Edward Hopkins Jenkins DR W E BRITTON, *Memorials, Recent Deaths* 537
Scientific Events
Expected Measles Epidemic, Weather Conditions in the North Polar Regions, The Wild Life Problem of the National Park System, Retirement of Dr Charles Wardell Stiles 539
Scientific Notes and News 541
Discussion
Is the Embryo Sac a Megaspore? PROFESSOR R B THOMSON *Work and Bodily Fatigue* PROFESSOR S R WILLIAMS *Effects of Breed on Embryo Size in the Domestic Fowl and the Rabbit* THEODORE C BYERLY *Oestrus Producing Hormones* DRS G F MARRIAN and A BUTENANDT *An Addition to the Herpetological Fauna of Kansas* J ERIC HILL *Do Peanut or Arachis Nut fed Hogs Yield Lards Containing Arachidic Acid?* PROFESSOR AUGUSTUS H GILL and GORDON T VAALA *A Motor Found in Nature* PROFESSOR OLUS J STEWART 544
Scientific Apparatus and Laboratory Methods
An Improved Drop Recorder PROFESSOR O S GIBBS *Film Lantern Slides* OTTO GLASSER 549
Special Articles
On Reflex Hyperlipaemia DR Y D KOSKOFF and PROFESSOR J G DUSSER DE BARENNE *Variations in Holopedium Species* PROFESSOR KATHLEEN E CARPENTER *Manganese and the Growth of Lemna minor* DR E F HOPKINS 550
Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE SECOND NEW ORLEANS MEETING

Edited by Dr. CHARLES F. ROOS

PERMANENT SECRETARY

THIRTY-FOUR scientific societies and the fifteen sections of the American Association will hold scientific sessions in New Orleans in convocation week This is the second New Orleans meeting, the first being held in December, 1905

Tulane University and the Convention Bureau of the New Orleans Chamber of Commerce have united in preparations for the meeting this year These have been able to secure financial backing in the raising of local funds to meet such expenses as lanterns and operators, screens, shutters, blackboards, clerks and attendants, printing of the general program, rent on meeting places, and other general expenses of the local committee Tulane University will give the general reception and furnish certain clerical help The city council of New Orleans has graciously appropriated funds to pay the rent on the splendid new Municipal Auditorium so that it will be available for evening lectures, scientific exhibits and certain joint sessions and symposia

Some of the scientific sessions will be held in the hotels, the Municipal Auditorium and the Tulane Medical School, which are down-town, but most of them will be held at Tulane University, which is about four miles up-town from this group A short article giving hotel assignments of societies and some interesting material concerning the host institution, Tulane University, appeared in SCIENCE for October 23

This second New Orleans meeting will be the eighty-ninth of the American Association and the annual meeting for the association year 1931–32, which began October first. Meetings of the executive committee and council will occur during the meeting week. Fifteen vice-presidents and numerous other officers of the association will be elected at this time.

The general program of the meeting, published under the auspices of the association, will be available on Monday at 9:00 A. M. and throughout the week at the association's registration office in the Venetian room of the Hotel Roosevelt. This book will be supplied free to all who register and may be purchased by others. Any person who does not attend the meeting may have a free copy of the program sent by mail if a request is addressed to the permanent secretary's office, Smithsonian Institution Building, Washington, D. C. It is usually not feasible to mail these programs until about January 10.

Numerous conducted excursions to the historical Vieux Carré, the famous French restaurants, the Cabildo and other points of interest will make the New Orleans meeting unique. (See SCIENCE, November 20, 1931.) Many families throughout the United States have signified their intention of spending the Christmas holidays in the pleasant, balmy climate of this Southern city. Because of this expressed desire of its members the association has been able to arrange with the railroads to sell convention tickets as early as December 20 from some points of the United States. Pre-Christmas selling dates have been secured for all points of the United States. It is hoped that many will take advantage of this opportunity to see New Orleans at a time when its climate is most delightful.

The American Association has arranged with the railway organizations for reduced railway rates at fare and a half for the round trip on the usual certificate plan. Any one may take advantage of these rates by securing a certificate for the A. A. A. S. meeting when purchasing his ticket to New Orleans. These will be on sale early enough to allow most members to spend Christmas in New Orleans if they so desire. Any one purchasing a ticket should be sure to secure a certificate *for the New Orleans meeting of the American Association for the Advancement of Science* and bring the certificate with him to the A. A. A. S. registration office. There will also be available short-limit winter tourist excursion fares (See SCIENCE for November 20). Many societies will maintain their own registration offices, but railway certificates can be validated only at the A. A. A. S. registration office in the Hotel Roosevelt. The association regularly charges a registration fee of $1 to its members and $2 to others. This fee is used to pay a small part of the cost of a meeting. The registration office will open on Monday morning, December 28, at 9 o'clock and will remain in operation throughout the week, hours from 9 to 6.

The second New Orleans meeting will be held under the presidency of Dr. Franz Boas, of Columbia University. Dr. Boas is known throughout the world for his many valuable contributions to anthropology. Dr. Boas will deliver an address and lead an important symposium on "Growth" at a joint session of Sections H (Anthropology), K (Social and Economic Sciences), and N (Medical Sciences). The retiring president this year is Dr. Thomas Hunt Morgan, of the California Institute of Technology. Dr. Morgan's contributions to zoology have been monumental. He will deliver the first of a series of five lectures at the opening general session on Monday evening, December 28, in the Municipal Auditorium.

The Sigma Xi lecture will be given at a general session on Tuesday evening at the same auditorium. The lecture will be by Dr. C. F. Hirshfeld, of the Detroit Edison Company.

Other general lectures will be given at the Municipal Auditorium on Wednesday, Thursday and Friday evenings by preeminent scientists. On Wednesday evening Dr. Richard Strong, of Harvard University, will deliver an address on some topic in tropical medicine. Professor Floyd Nagler, of the University of Iowa, will deliver the Thursday evening address on the general subject of "Engineering Problems of the Mississippi River." Professor Irving Fisher, of Yale University, will deliver the concluding lecture of the series on Friday evening on the topic, "First Principles of Booms and Depressions."

The annual Josiah Willard Gibbs lecture, arranged by the American Mathematical Society, will be given at a general session on Tuesday afternoon. The lecturer, Dr. P. W. Bridgman, of Harvard University, will speak on the topic "Statistical Mechanics and the Second Law of Thermodynamics."

Preliminary information indicates that there will be an unusually large number of joint sessions and symposia at New Orleans. Arrangements have already been made for at least twenty such sessions. A general session is being planned on the various aspects of aquiculture, the growing of plants and animals in water. The Committee of One Hundred on Scientific Research is planning to hold a session on "Scientific Research."

The New Orleans reception will be held on Monday evening following the opening evening lecture of the retiring president, Dr. T. H. Morgan. Admission to the reception will be by card obtained at the registration desk in the Roosevelt Hotel.

The regular exhibition of apparatus, books and products useful in science teaching or research by commercial houses will be held in the Venetian room of the Hotel Roosevelt. Those contemplating the purchase of such items can well afford to go to New Orleans just to visit this exhibit. An early sell-out of space indicates an unusually complete exhibit

It is expected that the scientific exhibition of research methods and achievements of research which was so successful at Cleveland will be greatly enlarged Several scientific institutions have already signified their desire to place scientific exhibits in the general scientific exhibition, which will be held in the Municipal Auditorium Exhibit space, power and power outlets, booths, tables, and so forth, will be furnished free to research exhibitors Scientists who are doing research which can be exhibited are invited to write at once to Dr F C Brown, the chairman of the Scientific Exhibits Committee of the association in care of the permanent secretary

IMPORTANT NOTICES FOR THOSE PLANNING TO ATTEND

Those who plan to attend this meeting should engage hotel rooms at once, addressing the hotels Whether the room desired is to be occupied by one or two persons should be stated, also the approximate price which the applicant wishes to pay and the date on which the room is to be occupied If the sort of room requested is not available for the given date, the hotel management will refer the request to the New Orleans Convention Bureau, which will tentatively assign a suitable room in another hotel, informing the applicant by letter If the applicant does not wish to accept the assignment thus given, he should inform the convention bureau, which will do its utmost to comply with his wishes Approved hotels are the following Roosevelt (general headquarters), St Charles, Monteleone, Jung, Marbere, De Soto, Bienville, La Salle, Chalmette, Lafayette, and Ponchartrain Apartment Hotel All these hotels are close together and convenient to the Municipal Auditorium and the Tulane Medical School An article giving more complete information in regard to hotels appeared in SCIENCE for October 23

When purchasing your railway ticket to New Orleans, be sure to secure a certificate for the New Orleans meeting of the American Association for the Advancement of Science, and bring the certificate with you to the registration offices for the meeting

THE AMERICAN ASSOCIATION PRESS SERVICE

(*By Austin H. Clark*)

Deep appreciation of and gratitude for the increasingly cordial spirit of cooperation toward the Press Service on the part of the members of the association is the outstanding emotion that arises in the mind of the director of the Press Service as the time for the New Orleans meeting draws near And the keenness of this emotion is intensified by the knowledge that the top-sergeant attitude of the director must to many be obnoxious This attitude—in reality quite foreign to his nature—is necessitated by the duties and responsibilities of his position. So instead of apologizing for it, he begs that the members will be so indulgent as to continue to regard him as an involuntary, though persistent, sinner.

The Press Service of the American Association for the Advancement of Science provides the representatives of the press with material from which they are enabled to prepare readable, accurate and timely items of scientific news It brings scientific workers and the representatives of the press together so that they may assist each other in placing before the American public a true story of the progressive advance of science in this country

In connection with the New Orleans meeting, as has been the case with previous meetings, the manuscripts and abstracts received from those who are to present papers will be made available to the press representatives as soon as they are received, in order that they may have ample time in which to go over them and study them The earlier a paper is received the more time there is for studying it This insures accuracy in the subsequent presentation of the subject-matter

So all who are to present papers at New Orleans are requested to send, as soon as possible, *two* copies of their manuscripts, each accompanied by an abstract, to the A A A S Press Service, Smithsonian Institution Building, Washington, D C A single copy will not suffice, and both copies are to be sent to the same address

The manuscripts sent to the Press Service of the association are not for publication as such They are solely for the use of press representatives in the preparation of news items or features They are regarded as confidential, and no one, except for properly accredited press representatives and members of the Association's Prize Committee, is allowed access to them.

No news story is released for publication in the press before the date on which the paper is read, no matter how long in advance it may have been prepared.

So far as possible the Press Service endeavors to supply the press with such additional information as will be advantageous in the proper presentation of a news item, and it also aids them in securing interviews with authors when such interviews are requested.

All manuscripts intended for use in connection with the New Orleans meeting should reach Washington not later than December 20 and if possible before December 15 Manuscripts arriving late may not receive attention The best science stories are written long before the meeting opens, when the writers have ample time for consultation and study in their preparation

Both manuscripts and abstracts should be written in the simplest possible language, in such a way as to be readily understood by any educated person with no detailed knowledge of the subject treated Especially should the broader aspects of the subject be presented, and its possible bearing on work in other lines and on thought in general

The director of the Press Service is ready at all times to answer questions concerning the work of the service and to aid authors so far as is possible But it must be remembered that for about two weeks before the meeting begins he is extremely busy, and it is quite impossible for him to do justice to all communications

The press is by far the most important medium for the dissemination of scientific knowledge among the people as a whole Realizing their responsibilities both toward the public and toward science, the press maintains a special corps of science writers whose duty it is to insure the proper presentation of scientific news and items Consequently it has now become a duty of scientific men to do their part and to assist the press, to the end that their findings may be clearly and accurately set before the public

THE AMERICAN ASSOCIATION PRIZE

The ninth annual award of the American Association prize, of one thousand dollars, will be made to the author of a noteworthy paper at New Orleans Through the generosity of a member who prefers to remain anonymous, eight of these prizes have thus far been awarded In making the award no attempt will be made to select the "best" paper presented, for useful comparisons are not possible in different fields of science, the intention is simply that the prize shall be awarded to the author of some notable contribution presented at New Orleans It is not necessary that the author be a member of the association All papers appearing in the General Program are automatically eligible, excepting certain invited papers on general programs and presidential and vice-presidential addresses, which are not eligible The donor of the prize desires to aid younger authors by means of the prize rather than to honor older men

The secretary in charge of each scientific program will be expected to present one or more nominations for consideration by the prize committee. There is to be no open competition and no submitting of papers for the prize It is supposed, however, that manuscripts of papers that may possibly be considered by the committee on prize award will all be in the hands of the Press Service, through the arrangements described above Secretaries should examine the manuscripts that have been received by the Press Service, which will have offices near the registration desks Nominations are to be in writing, signed by the secretary who sends them, and they are to be addressed to the Committee on Award, care of Mr Sam Woodley, at the registration offices, or else they may be sent to Mr Woodley in the Hotel Roosevelt

The permanent secretary and the other general officers of the association have nothing at all to do with the award, nor can they be in position to give out any information concerning the nominations until after the award has been officially announced The proceedings of the committee on prize award are to be strictly confidential

A list of the names of those to whom the association prize has been awarded is shown below, together with the topics dealt with in the winning papers

(1) The Cincinnati award, January, 1924 L E Dickson, for contributions to the theory of numbers
(2) The Washington award, January, 1925 Divided equally between Dr Edwin P Hubble, for contributions on spiral nebulae, and Dr L R Cleveland, for contributions on the physiology of termites and their intestinal protozoa
(3) The Kansas City award, January, 1926 Dr Dayton C Miller, for contributions on the ether-drift experiment
(4) The Philadelphia award, January, 1927 Dr George D Birkhoff, for mathematical criticism of some physical theories
(5) The Nashville award, January, 1928 H J Muller, for contributions on the influence of x rays on genes and chromosomes
(6) The New York award, January, 1929 Oliver Kamm, for contributions on the hormones of the pituitary gland
(7) The Des Moines award, January, 1930 A J Dempster, for contributions on the reflection of protons from a calcite crystal
(8) The Cleveland award, January, 1931 M A Tuve, L R Hafstad and O Dahl, for contributions on the production of beta rays and gamma rays by means of high voltage vacuum tubes

SCIENTIFIC SESSIONS OF SECTIONS AND SOCIETIES

Note—Names of organizations are arranged in the order of association sections. Each affiliated society has one or two representatives in the association council, as indicated by one or two asterisks before the society name A cross before a name indicates that the society is associated but not affiliated. The vice-president, retiring vice-president and secretary are named for each association section, the president and secretary are named for each society, and the council representatives for the affiliated societies Dates of meetings are to be read as inclusive

Hotel headquarters of societies have been announced in an article entitled "The Host Institution and Hotel Headquarters," which appeared in SCIENCE for October 23 For more complete information the General Program of the meeting, which will be available at the registration desk on Monday morning, December 28, should be consulted

A Mathematics

A-1——Section A of the Association December 28–31
Vice president, E R Hedrick, *retiring vice president,* G A Bliss, *secretary,* C N Moore

A-2—**American Mathematical Society December 28–30
President, L P Eisenhart, *secretary,* R G D Richardson, *council representatives,* Louis Ingold and Mark H Ingraham

A-3—**Mathematical Association of America December 31
President, E T Bell, *secretary,* W D Cairns, *council representatives,* W D Cairns and Dunham Jackson

On Tuesday morning, December 29, there will be a joint meeting of the American Mathematical Society, the American Physical Society, Section A and Section B, at which Professor G D Birkhoff, of Harvard University, and Dr W F G Swann, of Franklin Institute, will speak at the joint request of the various organizations concerned On Tuesday afternoon there will be a joint session of the American Physical Society, the American Mathematical Society, the Mathematical Association of America and Section A of the A A A S, at which the retiring vice-president for Section A, Professor G A Bliss, of the University of Chicago, will deliver an address on "The Calculus of Variations of the Quantum Theory" Later, on Tuesday afternoon, the ninth annual Josiah Willard Gibbs lecture, under the auspices of the American Mathematical Society and the American Association, will be delivered by Professor P W Bridgman, of Harvard University On Thursday morning there will be a joint meeting of the American Mathematical Society, the Mathematical Association of America and Section A, at which the retiring president of the first-named organization, Professor E. R Hedrick, of the University of California at Los Angeles, will deliver an address, as will also a representative of the Mathematical Association On Monday and Wednesday mornings and Monday afternoon there will be sessions of the American Mathematical Society for the presentation of research contributions On Thursday afternoon there will be a session of the Mathematical Association of America for the presentation of a number of invited papers On Thursday afternoon, either before or after the meeting of the Mathematical Association, Section A will join with Section K for an address by Dr E B Wilson on certain mathematical phases of growth analysis Wednesday afternoon is being reserved for an excursion, and an informal dinner for the mathematics group is scheduled for Wednesday evening. A joint dinner of the mathematical organizations will be held on Wednesday evening, at 6 30, at the Patio, which is one of the famed New Orleans restaurants This dinner will follow a conducted tour of the Vieux Carré

B Physics

B-1——Section B of the Association December 30
Vice president, Bergen Davis, *retiring vice-president,* F K Richtmyer, *secretary,* A L Hughes

B-2—**American Physical Society December 29–30
President, W F G Swann, *secretary,* W L Severinghaus, *council representatives,* W L Severinghaus and W F G Swann

B-3——*American Meteorological Society December 28–30
President, John Patterson, *secretary,* Charles F Brooks, *council representative,* W J. Humphreys.

B-4—**American Association of Physics Teachers December 31
President, H L Dodge, *secretary,* William S Webb

Section B will hold joint meetings with the American Physical Society and the American Meteorological Society The section has arranged to have two addresses (1) that of the retiring vice-president, Professor F. K Richtmyer, on "The Romance of the Next Decimal Place," and (2) that of Dr. H H. Kimball, of the Weather Bureau, on "Solar Radiation as a Meteorological Factor" At meetings of the American Meteorological Society there will be discussions of the "Airways Weather Service" and "Storm Tides and Coastal Currents Developed by Tropical Cyclones" Dr W F. G Swann, president of the American Physical Society, will deliver an address before it A symposium on certain topics in mathematics of interest to physicists is being arranged in conjunction with Section A (See Section A.) There will be a joint session of Sections B and E, the American Physical Society and the Society of Petroleum Geophysicists for invited papers on geophysics. There will also be the regular program of ten-minute contributed papers extending over three half days. There will be conducted tours through the Vieux Carré and to other points of interest

The program of the American Association of Physics Teachers will consist of a session devoted to invited papers dealing with various phases of the most recent developments in the teaching of physics and a *demonstration of apparatus having special teaching value* Dr Harvey B Lemon will deliver an address on "The New Physical Sciences Program at the University of Chicago"

C Chemistry

C-1—Section C of the Association December 29
Vice president, Charles Albert Browne, *retiring vice president*, James F Norris, *secretary*, R. R Renshaw

It is planned that Section C will hold at least two sessions at the New Orleans meeting One of these will deal with the importance of some of the minor constituents of the atmosphere as related to their chemical and biological significance and to the problems of atmospheric pollution

It is hoped that another meeting will be held jointly with the New Orleans section of the American Chemical Society, in which recent developments of the leading chemical industries in the South will be discussed

D Astronomy

D-1—Section D of the Association December 29
Vice president, Joseph H Moore; *retiring vice president*, D W Morehouse, *secretary*, Philip Fox
See announcement of Section L

E Geology and Geography

E-1—Section E of the Association December 30–January 2
Vice president, Douglas W Johnson, *retiring vice president*, Edson S Bastin, *secretary*, Kirtley F Mather
E-2—Society of Petroleum Geophysicists December 30
President, Donald C Barton

A regional committee under the chairmanship of Professor R A Steinmayer, of Tulane University, has been organized and a symposium on the "Geology of the Gulf Coastal Prairies" is planned for the Friday afternoon meeting The address of Professor Edson D Bastin, of the University of Chicago, retiring vice-president of the section, will be delivered at the afternoon meeting The annual dinner for geologists and geographers will be held on Friday evening Saturday, January 2, will be devoted to a field trip to the salt domes and mines of the Teche country Those taking the trip will board a Pullman in New Orleans, after the dinner on Friday evening, for New Iberia, Louisiana, and may return to New Orleans Saturday evening Those interested in the field trip should communicate directly with Professor Steinmayer at the earliest opportunity. Section E will join with the members of the American Physical Society and other organizations in a joint session for the *presentation of papers dealing with geophysics on* Wednesday, December 30, and arrangements will be made for short field excursions on Thursday, December 31 Arrangements have been made for special diverse-route fares on the round-trip identification plan, which will make it possible for geologists to purchase tickets from their homes direct to Tulsa, Oklahoma, for the meeting of the Geological Society of America and the American Association of Petroleum Geologists at that place, from December 28 to 31, and return *via* New Orleans, stopping there for the meetings of Section E on January 1 and 2

F Zoological Sciences

F-1——Section F of the Association December 28–January 2
Vice president, Robert W Hegner, *retiring vice president*, William Albert Riley, *secretary*, Geo T Hargitt
F-2—**American Society of Zoologists December 29–31
President, Fernandus Payne, *secretary*, William H Cole, *council representatives*, H. H. Newman and J Paul Visscher
F-3—**Entomological Society of America December 29–30
President, J W Folsom, *secretary*, J J. Davis, *council representatives*, W E. Britton and P P Calvert.
F-4—**American Association of Economic Entomologists. December 29–31
President, J. S Houser, *secretary*, A. F. Burgess, *council representatives*, Warren Elmer Hinds and Myron H Swenk.
F-5—**American Society of Parasitologists. December 29–30
President, W A Riley, *secretary*, Norman R. Stoll, *council representatives*, Robert W. Hegner and Henry B. Ward.
F-6——†Wilson Ornithological Club December 28–29.
President, J. W. Stack; *secretary*, Jesse M. Shaver.

Section F will meet jointly with the American Society of Zoologists on Tuesday, Wednesday and Thursday. The section will not hold sessions of its own for the reading of papers, but a short business meeting will be held on Wednesday afternoon at 2 P. M. A dinner for all zoologists will be held on Wednesday at 6:30 P. M. Dr. Robert W. Hegner, of the Johns Hopkins University, vice-president of Section F, will deliver an address immediately following the dinner, on "How the Other Half Live." Tickets for the dinner should be obtained in advance at the general registration office of the A A A S. in the Venetian room of the Roosevelt Hotel, or from the secretary of the American Society of Zoologists, Dr W. H Cole, at any of the regular sessions of the society The usual joint sessions of the American Society of Zoologists with the Parasitologists, the Geneticists and the Ecologists will be held Features of the program will be the demonstrations on Tuesday afternoon, a field trip on Tuesday afternoon (repeated on Thursday afternoon) and an invitation program on Thursday morning, at which four or five outstanding American zoologists will speak The Entomological Society of America will hold its twenty-sixth annual meeting on Tuesday and Wednesday The president for the meeting is Dr J W Folsom, of the U. S Bureau of Entomology, and the secretary is J J Davis, of Purdue University The Tuesday morning session will be devoted to business and reading of papers The Tuesday afternoon session will include a symposium on "The Blood-sucking and Non-Blood-sucking Flies in Relation to Human Welfare" On Tuesday evening the annual public address of the society will be given. Wednesday will be devoted to contributions, with a business session in the afternoon On Wednesday evening the society will join with the American Association of Economic Entomologists in the Annual Entomologists' Dinner The American Association of Economic Entomologists will meet on Tuesday, Wednesday and Thursday The business will be transacted at the opening session on Tuesday, at which time the president's address will be delivered The other sessions, except the closing business session of the association, which will be held on Thursday afternoon, will be subdivided in such a way that two or more groups will hold sessions at the same time On Tuesday afternoon, in addition to the general session, a meeting will be held by the Section of Apiculture and by the Section of Plant Quarantine and Inspection. On Wednesday morning a general session, together with a session of the Section of Plant Quarantine and Inspection and the Section of Extension Entomologists, will be held On that afternoon two groups of papers will be given at separate sessions—one on insect physiology and the other on insect toxicology, in addition to the general session. On Thursday morning a joint session will be held with the Cotton States Branch of this association. At this session there will also be presented four invitation papers on special phases of entomological work The Entomologists' Dinner will be held on Wednesday evening, December 30 The American Society of Parasitologists will hold its seventh annual meeting on Tuesday and Wednesday President W. A. Riley being out of the coutnry, the meeting will be in charge of Vice-President A. C Chandler, of Rice Institute, who has announced an address on "Susceptibility and Resistance in Helminthic Infestations." A joint session with Section N (Medical Sciences) is scheduled for Tuesday afternoon with the symposium topic, "On Parasitology of Medical Interest" Among the speakers will be Mr W E Dove, of the Bureau of Entomology, Dr R Hegner, of Johns Hopkins University, Dr P. D Lamson, of the Vanderbilt University Medical School, and Dr C W Stiles, of the National Institute of Health There will be a joint program also with the American Society of Zoologists Besides the usual sessions for the presentation of papers, appropriate time will be allotted for demonstrations The society will hold its annual business meeting and tea.

An added feature will be a Tuesday evening dinner

A session devoted to flood plain biology and aquiculture will be held on Monday afternoon The program for this session is in charge of Professor J G. Needham, of Cornell University

G Botanical Sciences

G–1——Section G of the Association December 28–January 2
Vice president, Elmer Drew Merrill, *retiring vice president*, E J Kraus, *secretary*, Sam F Trelease

G–2—**Botanical Society of America December 29–31.
President, Charles J Chamberlain, *secretary*, Arthur J Eames, *council representatives*, I F Lewis and L W Sharp

G–3—**American Phytopathological Society December 29–31
President, M W Gardner, *secretary*, F C. Meier, *council representatives*, C W Edgerton and Donald Reddick

G–4—**American Society of Plant Physiologists December 29–31
President, W. E Tottingham, *secretary*, W. A Gardner, *council representatives*, George J. Peirce and Charles A Shull.

Section G will hold a joint session with the Botanical Society of America, the American Phytopathological Society and the American Society of Plant Physiologists on Tuesday afternoon, December 29 Dr E. D. Merrill, vice-president for Section G, will preside. The retiring vice-presidential address will be given by Dr. E J Kraus, of the University of Chicago, on the subject, "The Organic Nutrition of Plants." This address will be followed by a symposium on "Tropical Botany," which will include introductory remarks by Dr E. D. Merrill and the following invitation papers: "The Progress of Botanical Exploration in Tropical South America," by Dr. H.

A Gleason, of the New York Botanical Garden; "Tropical Pathology and Mycology," by Professor F L Stevens, of the University of Illinois, "An International Program for a World-Wide Study of Woods," by Professor Samuel J Record, of the Yale University School of Forestry, and "Biological Survey of the Maya Area of Central America," by Professor H H Bartlett, of the University of Michigan The Botanical Society of America will hold its twenty-sixth annual meeting on Tuesday, Wednesday and Thursday Business sessions will be held each morning at 9, followed at 10 by scientific sessions of the four sections of the society In addition to the joint session which will be held with Section G of the American Association, there will be joint sessions with the Ecological Society of America and the American Society of Naturalists The Mycological Section will hold a joint session with the American Phytopathological Society The annual dinner for all botanists will be held on Wednesday evening At this time Dr L W Sharp, of Cornell University, will deliver the retiring presidential address The section programs of this society will be representative of their special fields, and all branches of botany will be dealt with in the papers presented

Morning sessions of the American Phytopathological Society are to open at 9 30 A M and afternoon sessions at 2 00 P M Joint sessions with other organizations are planned as follows (1) With Section G, Tuesday afternoon, the program being devoted to papers on tropical botany and plant pathology (2) With the Potato Association of America on Wednesday morning (3) With the Mycological Section of the Botanical Society of America on Wednesday afternoon There will be a round-table discussion on extension work in Plant Pathology on Tuesday afternoon, also a round-table discussion of quarantine and regulatory matters on Thursday afternoon The Tuesday morning program will be opened by remarks from the president, who will be followed by members presenting invitation papers A business meeting will follow the Tuesday morning program Arrangements for sessions on Wednesday and Thursday provide for presentation of numerous interesting and important contributions from members The annual dinner of the society is to occur Tuesday evening and tickets for this may be secured in advance at the general registration office of the A A A S in the Venetian Room of the Roosevelt Hotel or from the secretary at society headquarters in the St Charles.

The eighth annual meeting of the American Society of Plant Physiologists will occur from Tuesday to Thurdsay Sessions for the presentation of papers and the transaction of business will be held on Wednesday and Thursday Two joint sessions have been planned one with the American Society for Horticultural Science, on Tuesday morning, and the other with Section G, the Botanical Society of America and the American Phytopathological Society, on Tuesday afternoon The annual dinner has been scheduled for Thursday evening at the La Louisiane, for which tickets may be secured in advance at the general registration office of the A A A S At the dinner will be presented the second Stephen Hales address, by Dr W W Garner, U S Department of Agriculture, whose topic is "Photoperiodism"

F–G Botanical and Zoological Sciences December 29–31

FG–1—**American Society of Naturalists December 31
President, S J Holmes, *secretary*, L J Cole, *council representatives*, Herbert Kendall Hayes and A Franklin Shull

FG–2—**Ecological Society of America December 29–31
President, A O Weese, *secretary*, A E. Emerson, *council representatives*, Warder Clyde Allee and George P Burns

FG–3—**American Microscopical Society December 30
President, Harley J Van Cleave, *secretary*, James E Ackert, *council representatives*, James E Ackert and Harley J Van Cleave

FG–4——Genetics Sections, American Society of Zoologists and Botanical Society of America December 28–January 2
Chairman, L J Stadler, *secretary*, P W Whiting.

FG–5——†Phi Sigma Biological Research Society December 28 to 30
President, P B Sears, *secretary*, A I Ortenburger

The American Society of Naturalists will hold its regular symposium (in conjunction with the American Society of Zoologists and the Botanical Society of America) on Thursday afternoon The subject of the symposium has not yet been determined, but in accordance with established policy will be on "some borderline subject which would interest workers in more than one phase of biological research" The Naturalists' Dinner will be held on Thursday evening The dinner will be followed by the address of the president, Professor S. J Holmes, of the University of California, on the subject, "The Changing Biological Effect of Interracial Competition"

The American Microscopical Society will hold its annual business meeting and election of officers on Wednesday afternoon, December 30, at 4 o'clock. The Genetics Sections of the American Society of Zoologists and the Botanical Society of America will hold regular sessions for the reading of papers on Tuesday, Wednesday, Thursday and Friday mornings.

Afternoons will be devoted largely to exhibits and informal discussion. The committee chosen at the Cleveland meeting to organize an independent society of geneticists and to draw up a constitution will make its report at the business meeting. There will be a joint meeting with Geneticists Interested in Agriculture on Monday. Two symposia are planned—one on "Genetic Problems Involved in Bee Breeding," for the morning, and one on "The Genetics of Cotton Improvement," for the afternoon. No information has been received from the Ecological Society of America.

H. Anthropology and Archeology

H-1—Section H of the Association. December 28–January 2.
Vice president, William K. Gregory, *retiring vice president*, Carl E. Guthe, *secretary*, Charles H. Danforth.

Section H will hold meetings from Monday to Friday, chiefly in the Department of Middle American Research on the Tulane campus. Monday afternoon, Wednesday morning, Thursday afternoon and Friday morning will be given over to general papers and to local museums and libraries of anthropological interest. On Tuesday Section H will unite with Sections K and L in sessions devoted to Middle American problems. (See the announcement of Section L.) At the annual dinner, which will be held on Tuesday evening in the Maya Museum building, Dr. William K. Gregory, of the American Museum of Natural History, will preside as chairman of the section, and Dr. Carl E. Guthe, of the University of Michigan, will deliver his vice-presidential address on "The Maya Lunar Count." On Wednesday afternoon and Thursday morning Section H will join with Sections K and N in a symposium on "Growth," which will be led by Dr. Franz Boas, of Columbia University, president of the association, and Professor Richard E. Scammon, of the University of Minnesota. The opportunity which these meetings will afford for becoming familiar at first hand with the work being done at this important center of Middle American research is in itself a special attraction. Lunch in the French Quarter is planned for at least one day during the meetings.

I. Psychology.

I-1—Section I of the Association. December 29–31.
Vice president, Herbert Sidney Langfeld, *retiring vice president*, Edwin G. Boring, *secretary*, John E. Anderson.

I-2—†Southern Society for Philosophy and Psychology. December 29–31.
President, H. M. Johnson, *secretary*, Lyle H. Lanier.

On Tuesday evening, December 29, a joint program will be held with Section Q (Education) in the form of a dinner meeting, at which Professor Edwin G. Boring, of Harvard University, retiring vice-president of Section I, will give the vice-presidential address on "The Physiology of Consciousness," and Professor Leonard V. Koos, of the University of Chicago, the retiring vice-president of Section Q, will give his vice-presidential address. On the evening of December 30 the Southern Society for Philosophy and Psychology will hold a dinner meeting, at which Dr. H. M. Johnson, of the Mellon Institute, the president of the society, will give an address. Members of Section I who are not members of the Southern Society are invited to attend this dinner. The program sessions from the 29th to the 31st will be held jointly with the Southern Society for Philosophy and Psychology. These sessions will be open to contributions both from members of the Southern Society and from members of Section I who are not members of the Southern Society. On Thursday afternoon Section I will join with Section N (Medical Sciences) for a symposium on "Mental Disorders." (See the announcement of Section N.)

Members of Section I will find certain other programs of Section N of special interest.

K. Social and Economic Sciences

K-1—Section K of the Association. December 28–January 2.
Vice president, Griffith C. Evans, *retiring vice president*, Leonard P. Ayres, *secretary*, Harold Hotelling.

K-2—*Econometric Society. January 1–2.
President, Irving Fisher, *secretary*, Charles F. Roos.

K-3—†Metric Association. December 28.
President, George F. Kunz, *secretary*, Howard Richards.

Section K will hold sessions Monday afternoon and Wednesday morning for contributed papers. On Tuesday morning Section K will join with Sections H and L for a symposium on "Social and Economic Institutions of the Mayas." On Tuesday afternoon these sections will hold a symposium on "Commerce, Trade, and Monetary Units of the Mayas." (See announcement of Section L.) On Wednesday afternoon and Thursday morning Section K will join with Sections H and N for symposia on "Growth." The president of the association, Dr. Franz Boas, Dr. Harry Bakwin and Dr. Richard E. Scammon will give addresses at the Wednesday afternoon session, which will be devoted to the growth of the individual. The other session will be devoted to population growth, with papers by Dr. Scammon and others. Dr. Boas is in charge of the program on individual growth, and Dr. Henry Schultz is in charge of the program on population growth. On Thursday afternoon Sections K and L will join forces for addresses by Dr William B Munro, vice president for Section L, and Dr Robert G Caldwell, of the Rice Institute (See announcement of Section L) On Thursday afternoon at 4 30 Professor E B Wilson will deliver an address on certain mathematical phases of growth analysis at a joint session of Sections A and K On Friday Section L will meet jointly with the Econometric Society Addresses will be given by Professor Irving Fisher, Mr J B Canning, Professor G C Evans, Dr H Hotelling, Dr C F Roos, Professor E B Wilson, Dr W A Shewhart and Dr Joseph Mayer The president, Professor Irving Fisher, will speak on "The Scope of Econometrics"

L Historical and Philological Sciences

L–1—Section L of the Association December 29–31 *Vice president,* William Bennett Munro, *secretary,* Committee on History of Science, Joseph Mayer, *secretary,* Committee on Linguistics, Leonard Bloomfield

The program for the New Orleans meeting will center on the rise and development of the most ancient known civilization of the New World On Tuesday morning Section L will join with Sections H and K for a symposium on "The Social and Economic Institutions of the Mayas," and on Tuesday afternoon will join with these same sections for a symposium on "Commerce, Trade, and Monetary Units of the Mayas" Mr Frans Blom, of Tulane University, is planning an interesting exhibit in connection with the second symposium On Tuesday evening Section L will join with Sections H and D for papers on the "Astronomy of the Mayas" Wednesday will be devoted to excursions through the historical Vieux Carré and other sections of New Orleans. Thursday morning Section L will meet for a symposium on "Racial Antecedents and Linguistic Problems of the Mayas" On Thursday afternoon Section L will join with Section K for addresses by the chairman of Section L, Dr William B. Munro and Dr Robert G. Caldwell, of the Rice Institute Dr Caldwell's title is announced as "The Social Significance of American Panics"

M Engineering

M–1—Section M of the Association. December 29–31. *Vice president,* Dexter S Kimball, *retiring vice president,* Frank Baldwin Jewett, *secretary,* N H Heck.

It is expected that the meeting will occupy three half days, and on the afternoons there will be trips of inspections to the Spillway, twenty-five miles above the city, and to engineering works in the vicinity of New Orleans. The program will deal in part with hydraulics, especially in relation to the Mississippi River. There are expected to be papers on "Foundations of Structures," on the "Progress of Engineering in the Sugar Industry," on "Pipe Line Problems in Louisiana," and on certain engineering projects of local and general interest One of the general lectures of the association will be given by Professor Floyd Nagler on "General Engineering Problems of the Mississippi River" It is probable that this lecture will be preceded by a dinner

N Medical Sciences

N–1—Section N of the Association December 28–31 *Vice president,* Howard Thomas Karsner; *retiring vice president,* Louis B Wilson; *acting secretary,* Fred A Moss

On Monday afternoon Section N will meet for the address of the retiring vice-president, Dr Louis B Wilson Shortly after this address there will be a session for miscellaneous contributed papers On Tuesday morning there will be a session for miscellaneous papers on tropical medicine On Tuesday afternoon Section N will meet jointly with the American Society of Parasitologists for a symposium "On Parasitology of Medical Interest" Among the speakers will be Mr W. E Dove, of the Bureau of Entomology, Dr R Hegner, of the Johns Hopkins University, Dr P D Lamson, of the Vanderbilt University Medical School, and Dr. C W Stiles, of the National Institute of Health On Wednesday morning Section N meets for a symposium on "The Effect of Drugs and Internal Conditions on Behavior" The following invitation papers will be presented "Some Relationships between Personality and Body Chemistry," by Dr. Gilbert J. Rich, "The Effect of Extracts of the Anterior Lobe of the Hypophysis upon the Spontaneous Activity of the Rat," by Dr. Joseph G Yoshioka; "The Physiological Basis of Fatigue," by Dr Thelma Hunt; "The Effects of Fasting on the Psychologic Processes," by Dr J A Glaze; "Effect of Varying Periods of Sleep on Nervous Stability," by Dr. Katharine Omwake; "Fake Remedies Unearthed by the Pure Food and Drug Act," by Dr F. J. Cullen, of the U. S. Food and Drug Administration, U. S. Department of Agriculture. On Wednesday afternoon and Thursday morning Section N will join with Sections H and K for symposia on "Growth." (See the announcements for these sections.) On Thursday morning there will be a session of Section N for the following invitation papers: "The Part Played by Focal Infection in Mental Disorders," by Dr. M. L. Townsend, "Birth Injuries and Their Part in Mental Diseases," by Dr Leon Gordon; "Psychological Pathology with Normal Function as Shown by a Delinquent Group," by Dr. Lowell S Selling, "The Need of Objective Tests in the Diagnosis of Mental Disorders," by Mr H. F. Hubbard; "Poliomyelitis," by Dr F Eberson On Thursday afternoon Section N will meet jointly with Section I (Psychology) for a symposium on "Mental Disorders" The following invitation papers will be presented: "Psychological Approach to Functional Nervous Conditions," by Dr Abraham Myerson, "The Colloidal Chemistry of Psychiatry," by Dr Holmes Richter, "Some Medical Analogies in Abnormal Psychology," by Dr J M. Fletcher, "The Scientific versus the Psychic Approach to the Study of Mental Disorders," by Dr F A Moss

O. Agriculture

O-1——Section O of the Association December 28–31
    Vice president, Carlos Grant Williams, *retiring vice president,* Walter Castella Coffey, *secretary,* P E Brown
O-2—**American Society of Agronomy December 29
    President, W W Burr, *secretary,* P E Brown, *council representatives,* M A Mc Call and W L Slate
O-3——*Society of American Foresters December 29–31
    President, Paul G Redington, *secretary,* Franklin Reed, *council representative,* Harris Collingwood
O-4—**American Society for Horticultural Science December 28–30
    President, T H McHatton, *secretary,* Harold B Tukey, *council representatives,* W H Alderman and C P Close
O-5——†Potato Association of America December 28–30
    President, J S Gardner, *secretary,* H C Moore.
O-6——Geneticists Interested in Agriculture December 28
    Secretary, J L Lush

Section O will hold morning and afternoon sessions on Tuesday with the American Society of Agronomy, and papers will be presented on "Fertilizer Studies in Arkansas, in Texas, in Oklahoma and in Louisiana"; "Nitrogen Fertilizers and Nitrogen Requirements of Some Soils"; "Superphosphate Tests on Cotton"; "The Economy of Soil Nitrogen under Semi-Arid Conditions"; "Nitrification in Reclaimed Tidal Marsh Land"; "The Fertility of Various Organic Residues"; and "General Observations on Fertilizer Usage in the Southern States." On Tuesday evening a joint dinner will be held with the American Society of Agronomy and other associated societies, at which time Dean W. C. Coffey, of the University of Minnesota, will deliver the address of the retiring vice-president for Section O. The Society of American Foresters will hold their annual meeting on Tuesday and Wednesday, December 29 and 30 President Paul G. Redington, chief of the Biological Survey, will call the meeting to order at 9 30 A M Franklin Reed is executive secretary of the society and G. H Lentz is chairman of the arrangements committee Registration by the Foresters will be at 9 A M Wednesday morning's meeting is scheduled for 9 A M The afternoon sessions will open at 2 P M Following the address of President Paul G Redington, the Society of American Foresters will hold a symposium on "Forestry in the South" E L Demmon, director of the Southern Forest Experiment Station, will preside at this session. Professor R C Bryant, of the Yale Forest School, will be among the speakers The Tuesday afternoon session will deal with the use of aerial photography in forest mapping, the National Forest Survey, and a paper on the work of the Timber Conservation Board Dean H P Baker, of the New York State College of Forestry, will preside over the Wednesday morning session Papers at this session will deal with forest economics Carl Williams, of the Federal Farm Board, will present a paper on the "Land Use Problem of the South" Wednesday afternoon will be devoted to society affairs The annual dinner of the society will be held Wednesday at 7 P M at the Jung Hotel, for which tickets may be obtained from Miss Warren at the Society Registration desk The banquet will be followed by dancing An all-day field trip to Bogalusa to visit the forest plantations and the sawmill of the Great Southern Lumber Company mill is scheduled for Thursday. Details concerning this trip will be announced at the Tuesday sessions. A forest exhibit will be displayed with the scientific exhibition of the association. The American Society for Horticultural Science will hold sessions devoted to plant breeding and cytology, pomology, vegetable crops, ornamental horticulture, nutrition and possibly economics. The vegetable section will combine with the Potato Association of America on Monday afternoon On Wednesday morning there will be a joint session of all sections with the American Society of Plant Physiologists The annual horticulturists' dinner will occur on Tuesday evening, at which time the address of the retiring president, Dr. T H McHatton, of the University of Georgia, will be given The geneticists interested in agriculture will meet on Monday morning with the genetic sections of the zoological and botanical societies, This session will be devoted to a symposium on "The Genetical Problems Involved in Bee Breeding" The speakers will be Dr Anna R Whiting, Pennsylvania College for Women; Mr. H B. Parks, Texas Agricultural Experiment Station; Mr. W. J. Nolan, Bureau of Entomology; Mr. Everett Oertel, Bureau of Entomology, Mr G H Vansell, California Agricultural Experiment Station On Monday afternoon the program will consist of a symposium on "The Genetics of Cotton Improvement" The speakers will be Dr H B Brown, of the Louisiana Agricultural Experiment Station, Mr T H Kearney, of the Bureau of Plant Industry, Mr J F O'Kelly, Mississippi Agricultural Experiment Station, and Mr D T Millough, Texas Agricultural Experiment Station

Q Education

Q-1—Section of the Association December 28–30
Vice president, Ernest Horn, *retiring vice president*, Leonard V Koos, *secretary*, W L Uhl

Seven sessions of Section Q are planned for Monday, Tuesday and Wednesday A joint dinner of the section with Section I and with the societies of Phi Delta Kappa and Kappa Delta Pi is planned for Tuesday evening Following the dinner the retiring vice-president for Section Q, Dr Leonard V Koos, of the University of Chicago, will present an address The topics for the other sessions are "Research in Elementary Education," Monday morning, "Research in Secondary and Collegiate Education," Monday afternoon, "Research in Social Studies and other Problems of Character Training," Tuesday morning, "Research in Diagnostic or Remedial Work," Tuesday afternoon, "General Investigations in Teaching," Wednesday morning The attention of members of Section Q is called to the joint session of Sections I (Psychology) and N (Medical Sciences) on Thursday afternoon (See the announcement of Section N)

X Societies Related to the Association as a Whole

X-1—**Society of the Sigma Xi December 29
President, G W Stewart, *secretary*, Edward Ellery, *council representatives*, Edward Ellery and G W Stewart

X-2—*American Nature Study Society December 28–30
President, A F Satterthwait, *secretary*, Jennie Hall, *council representative*, J Andrew Drushel

X-3—**Honor Society of Phi Kappa Phi December 28–29
President, R C Gibbs, *secretary*, C H Gordon, *council representatives*, R C Gibbs and F D Kern

X-4—†Gamma Alpha Graduate Scientific Fraternity December 29
President, R W Babcock, *secretary*, H R Nelson

X-5—Sigma Delta Epsilon Graduate Women's Scientific Fraternity (Undecided)
President, Leva B Walker, *secretary*, Katherine Knowlton

X-6—Pi Gamma Mu Social Science Honor Society December 28–31
President, Leroy Allen, *secretary*, S Howard Patterson

On Tuesday afternoon the Society of the Sigma Xi will hold a business meeting, beginning at four o'clock. The annual dinner will occur Tuesday at 6 30, and the tenth annual Sigma Xi lecture will be given at the general session on Tuesday evening by Dr C F Hirshfeld, director of research of the Detroit Edison Company Tickets for the dinner may be secured, before Tuesday noon, at the general registration offices. The Webster Groves and the New Orleans branches of the American Nature Study Society will offer programs which will illustrate the excellent work accomplished by such units of the parent society An important business session will occur on Monday afternoon On Tuesday afternoon there will be a symposium on the subject of "Grade Placement in the Schools of Nature Study and Science" In this round-table discussion the society hopes to hear from a number of members who have experimented in this field or have otherwise contributed toward the solution of its problems Wednesday sessions will be devoted to contributions from members The society has an active committee arranging for an exhibit of educational nature and science materials The banquet will probably occur on Tuesday evening Possibly the society will join with other societies with similar interests in banquet and field trips or excursions Sessions of the Honor Society of Phi Kappa Phi will be held on Monday afternoon at 2 00 P M and on Tuesday morning at 9 00 A M The Monday session will be devoted to the reception of reports and the annual address of the president general, Dr R C Gibbs, of Cornell University The regular business session will occur on Tuesday The annual dinner of the society will occur on Monday evening in the Bienville Hotel, for which tickets may be secured at the general registration office of the A.A A S. and at the convention meeting The Gamma Alpha Graduate Scientific Fraternity will hold its council meeting on Tuesday morning and a breakfast on Wednesday morning A proposed plan for financing the councilors' traveling expenses to the annual convention will be considered

GENERAL OFFICERS OF THE ASSOCIATION FOR THE CALENDAR YEAR 1931, INCLUDING THE SECOND NEW ORLEANS MEETING

President

Franz Boas, Columbia University, New York, N. Y.

Retiring President

Thomas H Morgan, California Institute of Technology, Pasadena, Calif

Permanent Secretary

Charles F Roos, Smithsonian Institution Building, Washington, D. C.

General Secretary

Burton E Livingston, Johns Hopkins University, Baltimore, Md

Treasurer

John L Wirt, Carnegie Institution of Washington, Washington, D C

Secretary of the Council

Charles A Shull, University of Chicago, Chicago, Ill

Executive Assistant

Sam Woodley, Smithsonian Institution Building, Washington, D C

Auditor

A G McCall, U S Department of Agriculture, Washington, D C

Director of the Press Service

Austin H Clark, Smithsonian Institution, Building, Washington, D C

Manager of Annual Scientific Exhibition

F C Brown, Smithsonian Institution Building, Washington, D C

Manager of New Orleans Commercial Exhibition

H S Kimberly, Smithsonian Institution Building, Washington, D C

Officers of the Pacific Division

President A O Leuschner, University of California, Berkeley, Calif

Secretary of the Pacific Division J Murray Luck, Stanford University, Calif

Officers of the Southwestern Division

President John D Clark, University of New Mexico, Albuquerque, N Mex

Secretary E. F Carpenter, University of Arizona, Tucson, Ariz.

Members of the Executive Committee of the Council[1]

J McKeen Cattell (1934), *chairman*, Garrison on-Hudson, N Y

Franz Boas (1931), *president of the association*, Columbia University

Karl T Compton (1933), Massachusetts Institute of Technology

David R Curtiss (1931), Northwestern University

Joel H Hildebrand (1931), University of California.

Vernon Kellogg (1932), National Research Council

Burton E Livingston (1932), *general secretary of the association*, Johns Hopkins University

Robert A Millikan (1933), California Institute of Technology

Charles F Roos (1932), *permanent secretary of the association*, Smithsonian Institution Building

Henry B Ward (1934), University of Illinois

Edwin B Wilson (1932), Harvard University

Elected Members of the Council

Austin H Clark (1931), U S National Museum

Arthur H Compton (1931), University of Chicago

Frederick Gardner Cottrell (1934), Fixed Nitrogen Research Laboratory, Washington, D C

L O Howard (1932), U S Department of Agriculture

D T MacDougal (1932), Desert Laboratory, Tucson, Ariz

John C Merriam (1933), Carnegie Institution of Washington

Rodney H True (1933), University of Pennsylvania

Albert F Woods (1934), U S Department of Agriculture

OBITUARY

EDWARD HOPKINS JENKINS

On November 6, 1931, Dr Edward Hopkins Jenkins died suddenly at the age of 81 years For nearly fifty years, Dr Jenkins was a leader in thought and in the application of science to agriculture Trained as a chemist, he began his work in the chemical laboratory of the Connecticut Agricultural Experiment Station, the first agricultural experiment station to be established in the United States, some twelve years before the passage of the Hatch Act in 1887, which provided for such an institution in each state He served as vice-director of the station under Professor Samuel W Johnson from 1883 until 1900, when, after the resignation of Professor Johnson, he was appointed director He was also treasurer of the station from 1901 to 1923 In 1912 he was appointed director of the Storrs Agricultural Experiment Station and served as director of both stations until his voluntary retirement in 1923, when he was made director emeritus

Dr. Jenkins was born in Falmouth, Massachusetts, on May 31, 1850 He studied at Phillips Academy, Andover, and at Yale University, from which he was graduated in 1872 with the degree of bachelor of arts He carried on special studies at Yale from 1872 to 1875, under Samuel W Johnson, who was a pupil of John Pitkin Norton In 1875 and 1876, he studied at the University of Leipzig and at the Forest School, Tharandt, Saxony On returning to New Haven, he continued his studies at Yale, and the degree of doctor of philosophy was conferred upon him in 1879 In 1875, the Connecticut Agricultural Experiment Station was established at Middletown, and there Dr Jenkins, on returning from his studies abroad, served as chemist for a short time, being associated with Professor W O Atwater

In 1877, the station became a state institution and was transferred to New Haven Dr Jenkins now became chemist and served in this capacity until

---

[1] The number in parentheses denotes the calendar year at the end of which the member's term of office is to expire.

1900, when he became director During his directorship, there were established four new departments of station activity entomology, forestry, genetics and the tobacco substation at Windsor

In 1885, he was married to Elizabeth E Foote, who survives him

From 1897 to 1903, he served as chairman of the State Sewerage Commission, was president of the Graduates Club, New Haven, from 1900 to 1905, was president of the Association of Agricultural Colleges and Stations in 1913 He was a fellow of the American Association for the Advancement of Science, and a charter member of the Association of Official Agricultural Chemists, one of its early presidents, and a member of its first committee on food standards, appointed in 1897 Several years later the Secretary of Agriculture commissioned this committee to aid in fixing standards and formulating regulations for the enforcement of the new federal food and drug law For a period of several years he was one of the state chemists of Connecticut During the latter part of the World War, he was food administrator for New Haven He was a member of the Society for the Promotion of Agricultural Science, Connecticut Pomological Society, Connecticut Dairymen's Association, Connecticut Vegetable Growers' Association and many other local organizations He also served for several years on the governing board of the New Haven Hospital. In his college days he was a member of the Berzelius Society, Psi Upsilon fraternity, and later for many years was a member of the Patrons of Husbandry

Dr Jenkins was author and joint author of many station bulletins and reports, particularly concerning the chemical composition of fertilizers, feeding stuffs, foods and drugs, experiments in plant nutrition and the growing and curing of tobacco In cooperation with the Tobacco Experiment Company, he was the first to introduce the practice of growing tobacco under cloth in the Northern states

As editor of the first edition of the Century Dictionary he was responsible for the portion concerning chemistry He wrote several articles and sketches which were published anonymously, chiefly in *Harper's Magazine* and *Puck* and he was an occasional contributor to historical and scientific periodicals. He wrote many essays, verses and humorous sketches, some of which he read to his friends but never published After his retirement in 1923, he wrote the section on agriculture published in 1925 in Osborn's "History of Connecticut."

Dr Jenkins had an attractive personality and was very generous of his time and personal services in behalf of others. He always tried to help where help was needed. His innate modesty prompted him to refrain from appearing before large audiences, but his occasional addresses at large gatherings and his numerous papers read before smaller groups will never be forgotten by those who heard them. His services were in no small demand as toastmaster and speaker at agricultural, scientific and Yale Alumni banquets

Dr Jenkins was familiar with nearly all the native plants, and knew many of the birds and insects. This knowledge, combined with his happy temperament, made him a delightful companion for a stroll through the fields or along the country roads. His was one of the most cheerful and buoyant spirits that I have ever known Discouragement was evidently impossible to his nature He was a real optimist All who made his acquaintance became at once his lifelong friends and there are very many who mourn his passing His courage and kindliness, his loyal devotion to his work, his friends and his family, inspired all who came in contact with him.

Dr Jenkins believed in hard work and was never idle As director and colleague, he ever gave sympathetic counsel and encouragement to the members of his staff but was never insistent or obtrusive. He never delegated to his subordinates any of those disagreeable tasks that always arise in such institutions. He always tackled the job himself

As an administrator of public funds, Dr Jenkins was signally successful He always considered the interests of the taxpayer, and ever had the confidence of the people No public funds were ever expended with a greater union of economy and benefit in the results obtained than under his wise administration

Thus closes a long period of efficient and faithful service for the welfare of the people of his state and the nation.

W. E BRITTON

MEMORIALS

AT the recent Mount Rubidoux Sunset Armistice Day service, members of patriotic organizations and other citizens gathered on the mountain top and heard tributes to the late Dr. David Starr Jordan. A message was received from President Hoover, who wrote: "No greater tribute can be rendered to the memory of David Starr Jordan than to help build into current life and thought the ideals of world understanding and peace which he so consistently and effectively championed." Dr. Ernest C Moore, vice-president of the University of California, was the principal speaker. He spoke on "When Will War End?" Messages were also received from Dr Ray Lyman Wilbur, Secretary of the Interior, Dr. H. A. Garfield, president of Williams College; Dr. Nicholas Murray

Butler, director of the Carnegie Endowment for International Peace and president of Columbia University, and Dr. Henry S Pritchett, president emeritus of the Carnegie Foundation for the Advancement of Teaching.

THE ninth William Thompson Sedgwick Memorial Lecture will be given in the central lecture room of the Massachusetts Institute of Technology on Tuesday, December 1, at four-thirty o'clock by Dr Henry E Sigerist, institute for the history of medicine, University of Leipzig, Germany, on "The Philosophy of Hygiene"

IN honor of the late Charles S Sargent, for many years director of the Arnold Arboretum, Harvard University, a memorial arch will be erected across Center St, Jamaica Plain, near the Arboretum

THE twenty-fifth anniversary of Schaudinn's discovery of the *Spirocheta pallida* was celebrated by the College of Physicians of Philadelphia at a special meeting held on November 9 During the day there was a historical exhibit of incunabula, rare books, prints, portraits and medals relating to the whole history of syphilis, and a technical exhibit of equipment used in the various modern methods of diagnosis, with repeated demonstrations About 2,000 persons visited these exhibits. In the evening the following papers were read to an audience of about three hundred: "Is Syphilis America's Gift to the World?" by Dr. Jay F Schamberg, "Fracastoro and his Poem," by Professor Henry E Sigerist, Leipzig, "Schaudinn," by Dr John H Stokes

UNDER auspices of the New York Museum of Science and Industry, Dr Elihu Thomson, director of research of the Thomson Laboratories of the General Electric Company, and Professor Dugald C Jackson, head of the electrical engineering department of the Massachusetts Institute of Technology, spoke at an especially arranged meeting in observance of the Michael Faraday Centenary. The addresses were delivered to an invited group of scientists, technologists and industrial leaders in the auditorium of the Engineering Societies Building, New York City

RECENT DEATHS

DR JOSEPH CLARK STEPHENSON, professor of anatomy at Louisiana State University Medical Center, died in New Orleans on November 10 at the age of forty-five years

DR. GEORGE ROGER ALBERTSON, formerly professor of anatomy and dean of the School of Medicine at the University of South Dakota, died on November 3 at the age of eighty-five years

DR. WALTER FRANCIS REID, one of the original members of the Society of Chemical Industry, of which he was president in 1910, the inventor of smokeless powder, died on November 18 He was eighty-one years old

THE death is announced of Dr James Sholto Cameron Douglas, professor of pathology in the University of Sheffield and dean of the Medical School

SCIENTIFIC EVENTS

EXPECTED MEASLES EPIDEMIC IN LONDON

THE *British Medical Journal* says that an epidemic of measles in London, according to a report of the Central Public Health Committee of the London County Council, is expected during this autumn and winter. Measles epidemics in London appear to occur biennially, beginning in the late autumn, reaching their meridian in March, and taking some six or seven months to complete the circle of London The last epidemic occurred in the autumn and winter of 1929–30, and the next is therefore almost due. During each measles epidemic in London not fewer than 50,000 children are affected. The committee points out that measles is an infection which does not lend itself ideally to hospital treatment, and therefore home nursing should be encouraged in all cases where it can be carried out under reasonably favorable conditions Where satisfactory home nursing can not be obtained, every effort should be made to secure the patient's admission to hospital at as early a stage of the illness as possible. The council has 4,634 beds in its town fever hospitals, and 2,868 more in outlying and convalescent hospitals During measles epidemics every case of scarlet fever that can either be kept at home or sent to one of the outlying hospitals renders a hospital bed available for measles. It is considered that if measles cases are admitted before complications have developed, a period of fourteen days is usually adequate for hospital treatment. The number of beds that can be set apart for measles depends largely on the incidence of diphtheria, which must be given priority of admission over both scarlet fever and measles; much depends also upon the incidence of small-pox. If the fever hospital accommodation is unduly taxed for other conditions, arrangements will have to be made for assistance from the general hospitals under the council's control during the period of expected greatest pressure—namely, February to April, 1932 Attention is drawn to the assistance which the public, especially parents, can give. Despite much propaganda, the belief persists that measles can be lightly treated without medical and nursing assistance, yet during the last four years measles has caused eight times as many deaths as scarlet fever, and one and a half times as many as diphtheria The deaths from measles in London are diminishing, however, as seen from the figures for recent quinquenniums

1906–10	9,538	1921–25	3,859
1911–15	9,596	1926–30	3,715
1916–20	5,830		

Important points in mitigating the effects of an epidemic are (1) to make every effort to postpone contraction of the disease until after the third or fifth year, because the younger the child the greater is the risk of serious illness, (2) to secure adequate medical, nursing and hygienic care, (3) to have regard to the fact that measles is particularly fatal among children under-nourished or living under unfavorable conditions

WEATHER CONDITIONS IN THE NORTH POLAR REGIONS

PLANS for intensive study of weather conditions in the North Polar regions during 1932, designed to provide comprehensive information on air movements and other meteorological data as a basis for improvement of weather forecasting, were developed at the recent conference of the executive council of the International Meteorological Organization in Locarno, Switzerland According to Dr C W Marvin, chief of the United States Weather Bureau, who gave the information to a representative of the *U S Daily,* the program is to be carried on by practically every country with possessions in the northern hemisphere

Plans originally developed for the studies included establishment of additional weather observatories in the Arctic regions. Some of these will be provided, but economic conditions have been such that some of the governments involved have had to curtail their plans However, additional observations are to be made at stations already existing where new stations can not be established, and every available means to increase information on polar conditions will be used

Canada is to establish additional stations in the northern regions The United States already had provided extra funds for studies in Alaska, primarily with a view to development of airways, so increased funds probably will not be asked. Russia, Norway, Sweden, Greenland and other northerly nations are cooperating.

The objective is to discover the laws of physics in the atmosphere and of its great, general circulation. Information is wanted on the atmosphere from pole to pole. Whether or not the information obtained will enable extension of the period for which weather forecasts can be made accurately can not yet be foretold

THE WILD-LIFE PROBLEM OF THE NATIONAL PARK SYSTEM

As the first step toward correlating and solving the wild-life problem of the growing national park system, three representatives of the park service of the University of California, Joseph Dixon, economic mammalogist, George M Wright, alumnus of the University of California, and Ben H Thompson, alumnus of Stanford University, are preparing an inventory and preliminary report which has necessitated more than two years of study and 43,000 miles of travel through thirteen parks in this country and four in Canada

Among the recommendations of the survey are (1) the future restoration of exterminated species of birds and animals, such as wild turkey in parks of the Southwest, and mountain sheep in Yosemite, (2) development of protection for species which are threatened with extinction, such as the trumpeter swan of Yellowstone, (3) control of species which have become too abundant through increase in food supply or disappearance of natural enemies, such as deer in Yosemite and the Kaibab, and bear in the Yellowstone, (4) fixing of boundaries in present and future parks to include winter as well as summer range and protection for animals, and (5) overcoming conflict between wild-life species, or between wild-life and humans, such as the eating of planted fish by birds, and the encroachment of bears and skunks on human habitations

The suggestion that such a survey be made came from Mr Wright while he was serving as an assistant park naturalist in Yosemite To overcome possible difficulties he volunteered to sponsor the survey until the government is in a position to take it over

The ultimate purpose of the survey, after determining the immediate wild-life problems of national parks in order of urgency, is to assist Director Albright in formulating a definite wild-life policy to maintain the parks in as near to their original condition as possible through future generations In addition it will provide the necessary data for the use of the director in organizing a permanent wild-life division in the National Park Service

RETIREMENT OF DR CHARLES WARDELL STILES

DR. CHARLES WARDELL STILES, who was retired from active duty in the U. S Public Health Service on October 1, 1931, was tendered a farewell dinner by his colleagues on October 7, at the Cosmos Club, Washington. Before entering the Public Health Service as chief of the division of zoology in the Hygienic Laboratory (now the National Institute of Health), Dr Stiles was chief of the zoological division of the Bureau of Animal Industry A distinguished gathering, representing the Public Health Service, Bureau of Animal Industry, Bureau of Plant Industry, Bureau of Biological Survey, U S National Museum, the medical departments of the Army and of the Navy, the Johns Hopkins University and various other groups were present at the dinner Dr Hall presided and the following speakers discussed Dr. Stiles' services in connection with the topics noted Dr L. Stejneger, "Dr Stiles and the International Commission of Zoological Nomenclature", Dr Wm H Welch, "Medical Aspects of Dr Stiles' Work on Hookworm", Dr W S Thayer, "Dr Stiles and His Work in Medical Fields", Dr A. M. Stimson, "Dr Stiles' Work in the Public Health Service", Dr T S Palmer, "Dr Stiles as a Zoologist", Dr Paul Bartsch, "Dr Stiles and the Helminthological Society of Washington", Dr C L Marlatt, "Dr Stiles' Work in Entomology", Dr Benjamin Schwartz, "Dr Stiles' Work in the Bureau of Animal Industry," and Dr N A Cobb, "Dr Stiles Himself"

SCIENTIFIC NOTES AND NEWS

AT the dinner held in connection with the New Haven meeting of the National Academy of Sciences on November 17, tributes to Othniel Charles Marsh were presented by Professors Charles Schuchert and Richard S Lull, in memory of the one hundredth anniversary of his birth, which occurred on October 29, 1931 Marsh gave to Yale University his services, his great paleontological collections and his estate He was president of the National Academy from 1883 to 1895

THE Draper Medal of the National Academy was presented at its dinner to Dr Annie Jump Cannon, curator in the Harvard Observatory, for her work on the classification of stars by means of their photographic spectra Professor Harlow Shapley, director of the observatory, made the presentation address The Agassiz Medal for oceanography was presented to Professor Henry Bryant Bigelow, of Harvard University, and director of the Oceanographic Institution at Woods Hole, with an address by Professor George H Parker

THE Frederick Ives Medal of the Optical Society of America has been awarded to Dr Theodore Lyman, Hollis professor of mathematics and natural philosophy, emeritus, and director of the Jefferson Physical Laboratory at Harvard University

THE John Scott Medal was presented on November 18 at the Franklin Institute to Professor Philip Drinker and to Mr Louis Agassiz Shaw, of the School of Public Health of Harvard University, in recognition of their invention of the Drinker respirator They presented a paper entitled "Prolonged Administration of Artificial Respiration"

GENERAL JAN CHRISTIAAN SMUTS, formerly premier of South Africa, retiring president of the British Association for the Advancement of Science, has been elected rector of St Andrews University

IT is expected that Professor Albert Einstein will spend the winter at the California Institute of Technology

DR ALLEN O WHIPPLE, professor of surgery at the College of Physicians and Surgeons of Columbia University, since 1921, is the first incumbent of the newly established Valentine Mott professorship of surgery The trustees, in creating the new chair, proposed that it be so named in recognition of the "long and distinguished service of one of the most eminent surgeons in the whole history of New York."

FOLLOWING the resignation of Director James T Jardine, of the Oregon Agricultural Experiment Station, to become chief of the Office of Experiment Stations, Mr William A Schoenfeld, regional representative of the Federal Farm Board at Portland, has been appointed dean and director

MR CHARLES ALFRED WEATHERBY has been promoted to be assistant curator of the Gray Herbarium of Harvard University Miss Marjorie W Stone has been appointed bibliographer, succeeding Miss Winifred E Burrell

MR ERNEST J TEBERG, of Chicago, has been appointed curator of the railroad transportation division of the Museum of Science and Industry of Chicago

DR DON M GRISWOLD, formerly professor of hygiene and public health, University of Iowa, has been provisionally appointed consulting epidemiologist on the Division of Communicable Diseases of the New York State Department of Health

DR J S YOUNG, lecturer in experimental pathology and assistant director of cancer research in the University of Leeds, has been appointed Musgrave professor of pathology at the University of Belfast.

Professor Henri Lecomte, for many years curator of the phanerogamic herbarium of the Muséum d'Histoire Naturelle in Paris, retired on October 1 He is succeeded by Professor Henri Humbert

Dr. Haven Emerson, professor of public health administration at Columbia University and formerly health commissioner of New York City, has been appointed chairman of a committee on sanitation, public health and water supply of the Merchants' Association of New York The association has undertaken a study of the sanitation and sewage disposal problems of the city

Dr. Edward R. Weidlein, vice-president of the Board of Trustees of the Mellon Institute of Industrial Research and also director of that institution, has been elected a member of the board of trustees of the University of Pittsburgh for the period 1931–34. The Mellon Institute is allied with the University of Pittsburgh

The Experiment Station Record reports that Director F B Linfield, of the Montana College and Experiment Station, has had leave of absence for four months ending in December to be spent in the Orient It was planned to visit Japan, China, India, Australia, New Zealand and the Fiji and Hawaiian Islands A report will be presented on the agricultural outlook in Australia and New Zealand, with particular attention to grain and dairy production During his absence, Mr Clyde McKee, who returned to the institution in June, after a year of travel and graduate study, is serving as acting director

Arthur Paul Jacot, formerly acting head of the department of biology of the Shantung Christian University, after spending three months collecting topotypes of European Acarina through a grant of the Elizabeth Thompson Science Fund, is continuing his studies on the moss mites at the Osborn Zoological Laboratories of Yale University

Dr. William Filewicz, a delegate of the minister of agriculture in Poland, recently visited the College of Agriculture of the University of Wisconsin to observe methods of apple growing

The seventh annual Norman Lockyer Lecture of the British Science Guild was given by Dr H H Dale on November 24. The subject of the lecture was "Biology and Civilization"

Dr William Morris Davis, emeritus professor of geology at Harvard University, will give on November 30 before the New York Academy of Sciences at the American Museum of Natural History an illustrated lecture on "The Coral Reef Problem."

Dr. Herbert Grove Dorsey, of the U. S. Coast and Geodetic Survey, recently gave a lecture at the Catholic University on "The Fathometer and other Applications of Acoustics in Hydrographic Surveying."

Professor Kyoji Suyehiro, director of the Earthquake Research Institute of the Tokyo Imperial University, gave an illustrated lecture on his earthquake studies in Japan with emphasis on the engineering aspect at an open meeting of the Saint Louis University Sigma Xi Club, on November 16

The Sigma Xi Club of the University of Buffalo held its first regular meeting of the current year on November 11, following a dinner at the Campus Edge restaurant Dr G H Cartledge, the newly appointed professor of chemistry, addressed the members on "Changes in the Periodic System" Officers of the club are Professor Grant Hector, *president*, and Dr Howard W Post, *secretary-treasurer*

Lectures given during November at the Duke University School of Medicine and Duke Hospital include Dr R W Hegner, of the Johns Hopkins School of Hygiene, on 'Parasitology", Dr Louis B Wilson, director of the Mayo Foundation, and Dr Eugene F DuBois, professor of medicine at Cornell University School of Medicine, on "Metabolic Factors in Hyperthyroidism and Typhoid Fever at the Duke Hospital."

The University of Pittsburgh (Xi Chapter of Phi Lambda Upsilon) sponsored two lectures by Dr Harry Sobotka, of the Rockefeller Institute and Mt. Sinai Hospital, New York City, which were given during October, the first in conjunction with the American Chemical Society on "The Biochemistry of Bile Acids," the second at the University of Pittsburgh on "The Specificity of Enzymes"

The De Lamar lectures at the Johns Hopkins School of Hygiene and Public Health are being given as follows Dr. R E Dyer, acting director of the National Institute of Health, Washington, "The Typhus-Rocky Mountain Spotted Fever Group of Diseases"; Dr Victor G. Heiser, associate director, International Health Division, Rockefeller Foundation, "Disease Control and the League of Nations"; Dr Edgar Sydenstricker, director of the division of research, Milbank Memorial Fund, "Statistics of Morbidity"; Dr. Arthur I Kendall, professor of research bacteriology, Northwestern University Medical School, "Filterability of Bacteria"; Dr. Charles Armstrong, surgeon, United States Public Health Service, "The Complications of Smallpox Vaccination", Dr W. H. Taliaferro, professor of parasitology, University of Chicago, "Experimental Studies on Monkey Malaria"; Dr Albert G. Love, Lieutenant-Colonel, Medical Corps, U. S. A., "Some Aspects of the Vital Statistics of the United States Army and their Value in Public Health."

A SYMPOSIUM summarizing present knowledge of poliomyelitis was held in Albany, New York, on November 12, under the auspices of the state department of health and a group of pediatricians of New York and adjacent territory in Canada. Among the speakers were Drs. William Lloyd Aycock, director, Harvard Infantile Paralysis Commission, Boston, George Draper, associate professor of clinical medicine, Columbia University College of Physicians and Surgeons, Simon Flexner, director, Rockefeller Institute for Medical Research; William H Park, director, bureau of laboratories, New York City department of health, and Dr John G FitzGerald, director, Connaught Laboratories, University of Toronto

THE semi-centennial meeting of the Staten Island Institute of Arts and Sciences was held on November 11 The meeting was attended by four of the founders, Mr William T Davis, Dr N. L Britton, formerly director of the New York Botanical Gardens, Dr Arthur Hollick, paleobotanist on the staff of the New York Botanical Gardens, and C W Leng, director of the Staten Island Public Museum The fifth survivor, Edward C Delavan, Jr, was unable to attend Preceding the meeting a reception was held at the institute, during which all departments of the museum were open for inspection A gift was announced of $2,000 from Mr Davis, president, to be applied to the foundation of a Natural Science Fund

THE one hundred and seventy-third regular meeting of the American Physical Society is being held at the Ryerson Physical Laboratory of the University of Chicago on November 27 and 28 Other meeting for the current season are as follows December 18–19, Pacific Coast, Berkeley, annual meeting, New Orleans, December 29–30, February 25–27, 1932, Cambridge; April 28–30, Washington, June, Pacific Coast, Pullman, Washington; June meeting, New Haven

THE annual meeting of the American Society of Mechanical Engineers will be held in New York City from November 30 to December 4

THE annual meetings of the American Anthropological Association and the American Folk-Lore Society will be held on December 28 and 29, at Phillips Academy, Andover, Mass.

THE seventeenth annual meeting of the Radiological Society of North America will be held in St. Louis, from November 30 to December 4, with Dr Bundy Allen, Tampa, Florida, as president

THE annual congress of the British Institute of Radiology will be held at the Central Hall, Westminster, on December 2, 3 and 4 In association with the congress an exhibition of x-ray apparatus will be held in the same building under the auspices of the British x-ray industry

THE inaugural meeting was recently held at the London School of Hygiene and Tropical Medicine, of a new club to be called the "Thirty-one Club," in which it is intended to unite men of diverse scientific interests in order to make known the progress of different branches of science Sir Richard Gregory, editor of *Nature*, presided

FOR its International Polar Year Expedition the Canadian Meteorological Service has received a special grant to apply this year for the purchase of instruments and for the preliminary arrangements The main magnetic station will be at Chesterfield Inlet Four or five other stations will be established principally for meteorological work

THE Boston Dispensary has recently created and established a department of clinical research Dr William A Hinton is the director. Research has been carried out at the Boston Dispensary in connection with the various services for about four years The definite organization of the research activities into a department represents an appreciation of the value research has been found to have in the investigation of clinical conditions among the large out-patient clientele of the dispensary

CLASSES in the Engineering School of Columbia University have been opened to unemployed professional engineers, according to an announcement made by Dean Joseph W Barker Applicants must secure a certificate from the Engineers' Committee on Unemployment, of which H de B Parsons is chairman, showing that they are accredited members of the profession and that they are idle through no fault of their own They will present these credentials to Dean Barker who will assist them in arranging their class attendance The number of the engineers admitted will be limited only by the size of the lecture halls. Catalogues and class schedules have been sent to the committee, which has its headquarters in the Engineering Societies' Building, 29 West 39th Street, and which is endeavoring to find work for approximately 2,500 unemployed engineers in the Metropolitan district.

SYRACUSE UNIVERSITY announces the establishment of an independent department of psychology, with Dr. Ernst Thelin as head of the department. Until the present time, psychology and philosophy have formed a single department, despite the fact that in nearly all other universities they have established separate organizations.

THE first book in a series of brief scientific volumes sponsored by the Century of Progress Exposition—

Chicago's 1933 World's Fair—has been published by Williams and Wilkins The title is "The Queen of the Sciences" and the author is Dr E T Bell, professor of mathematics at the California Institute of Technology The books in the series will be written in a non-technical style. Each will deal with some phase of the advance of science and invention during the past century The series will be published, one book at a time, throughout 1932 and the early part of 1933 The books will average from 25,000 to 30,000 words each The program includes a book on the automobile, giving an insight into the industry and its effects on society, by Mr C F Kettering, of the General Motors Corporation, a book on communication—radio, telephone, telegraph—by Major-General Squier, on astronomy by Dr R H Baker, of the University of Illinois, on chemistry by Dr L V Redman, of the Bakelite Corporation, on steel and its relation to people, by Dr G M Eaton, on electrochemistry, by Dr G L Mantell, and on development of the evolutionary theory, by Dr H H Newman

The Experiment Station Record reports that because of the financial depression, reductions were made by the last Nebraska legislature in appropriations for most of the expending agencies of the state The direct tax appropriation for the University of Nebraska was reduced approximately 5 per cent as compared with two years ago, and of this amount the station assumed approximately 4 per cent. of its direct tax appropriation The revolving funds made up of cash receipts have also been reduced by the lower prices received for farm products Provision was made, however, for some building, the College of Agriculture being allotted $15,000 for cottages for the North Platte Substation and $75,000 for rebuilding the animal husbandry building, partially destroyed by fire during the spring, while a special appropriation of $20,000 was made for a shop building at the Curtis School of Agriculture

According to *Museum News*, the Greater St Louis Museum of Natural History, which was incorporated October 30, 1930, is planning to erect a building and has had plans drawn by W P Manske and associates. It will provide quarters for departments of astronomy, including a planetarium, geology, zoology, anthropology and related subjects The first three floors of the building are planned to house exhibits of the above-mentioned subjects in natural settings On the fourth and fifth floors the plan places scientific collections, laboratories and curators' offices The fourth floor also provides for an extensive library on the natural sciences The planetarium will be on the fifth floor The ground floor is to have a lecture hall with a seating capacity of 800, also a cafeteria and kitchen The exhibit floors will be inclined so that no stairways nor elevators will be required, although these will be available for those who desire to use them It is proposed to erect the museum building on the Memorial Plaza, a downtown location, covering a block 300 feet square The building will cost approximately three million dollars and the museum association will seek a bond issue for this purpose Mr Hermann Schwarz is president of the organization and Mr Edwin P Meiners is secretary-treasurer

DISCUSSION

IS THE EMBRYO SAC A MEGASPORE?

Seventy-five years and over seems a long time for a misconception of fundamental importance to have been persistently associated with one of the most classic contributions to the science of botany Yet such an anomaly exists in connection with Hofmeister's comparative researches of the middle of the last century—researches which paved the way in the plant world for the reception of the biological principles that Darwin announced a few years later When Hofmeister established homology between the free-sporing condition in the vascular cryptogams and the seed habit of the higher forms he unfortunately chose for comparison with the seed plants certain of the heterosporous forms of the vascular cryptogams His points of comparison are interesting from the fact that difference in size of spore, the basic feature of heterospory as ordinarily understood, is not one of them. Even in the figures that he used to illustrate his work there is no hint that he regarded difference in size of the spores in the seed plants as important In fact, Hofmeister seems to have carefully avoided, whether intentionally or not, any reference to the embryo sac as being a large spore, stating his epoch-making generalization simply as follows "Der Embryosack der Coniferen lasst sich betrachten als eine Spore, welche von ihrem Sporangium umschlossen bleibt" Since Hofmeister's time, however, it has been universally assumed among botanists that the ovule does contain a big spore (*mega-* or *macro*-spore) and that the seed plants are heterosporous with regard to size, some botanists even going so far as to suggest that the larger the female spore the greater the chance of its being retained. The anomaly of this situation would have been long ago apparent had any one taken the trouble to measure and compare the size of the male and f[illegible] spores in the seed plants, since the pollen o[illegible] spores are in some cases even larger than th[illegible] spores, and when the reverse is the case the [illegible] is insignificant when compared with that in the heterosporous vascular cryptogam where the large spore may be as much as 30,000 times the bulk of the small one

If excuse be sought for not making measurements where size is concerned it may perhaps be found in two things. The female spore of the seed plants (the embryo sac initial cell) does not look like a spore since it has a very thin wall, no storage products (such as starch, oil, etc), and is in intimate contact with surrounding nutrient cells In the second place, it does not long remain a spore, soon undergoing prothallial development and increasing very rapidly in size The large size at this stage of development does undoubtedly tend to make one assume that the spore must originally have been large, without troubling to measure it How different, however, is the true megasporous conditions Nearly all, if not the whole, increase in size of the megaspore over the microspore occurs before prothallial development begins, and the food supply from the mother plant is stored in the spore, where it is protected against the vicissitudes of the free-sporing habit of the resting stage by a thick suberized coat It can get no further supply from the mother plant, either during prothallial or embryonic development, whether the spore be shed at once or retained longer in the sporangium In contrast to this, the enclosed spore of the seed plants starts out small, grows rapidly while undergoing its prothallial and embryonic development, and finally ceases growth and comes to its resting or storage stage only when the ovule has matured into the seed.

It is not intended in this statement to go farther into the *proof* that the seed plants are homosporous[1] but to refer briefly to some of the anomalous statements that are included in our text-books because of the assumption that the enclosed spore of the seed plants is a megaspore In the first place the classic text-book choice for comparison with the seed plants is selaginella, although very often in some other part of the same text there is found a statement that the fern ancestry of the seed plants has been demonstrated beyond doubt Perhaps if the text-book is an advanced one there may even be a statement that it is the eusporangiate ferns that show more relationship to the seed plants, the author often considering it necessary to apologize for drawing attention to these facts as the eusporangiate ferns are all homosporous, while the *Leptosporangiatae* contain many heterosporous forms.

In the text-book of the future, even if the author is still a confirmed megasporist, may we not at least ask that he insert a drawing to scale of the male and female spores of the seed plant, to give substantial and convincing visible proof of his view He might also add to the ordinary comparison of seed plants and eusporangiate ferns a reference to such things as the similarity in mode of food absorption, organization and orientation of the embryo in the gymnosperms and certain of these eusporangiate forms. Perhaps an illustration of these pertinent features might be included, even if the ubiquitous figure of selaginella had to be omitted

R B Thomson

Department of Botany,
University of Toronto

WORK AND BODILY FATIGUE

The text-book of physics, which I studied as a high-school student, said that no work was done in carrying a load along a level path I knew this was incorrect because as a boy I had carried large forkfuls of hay along the loft floor of the barn, to be thrown down to the cows and horses below, and had become weary in well-doing

A similar concept of work holds in the statement that no work is done in holding a mass out at arm's length Just let any one who believes this statement hold a kilogram mass in this fashion for eight hours (union labor) and see if he thinks he has not been doing work! What is the discrepancy between these statements in our physics text-books and our experiences in life? Is it not fair to say that they should check with each other?

The Milwaukee Road has electrified its railway over the Rocky Mountains Powerful electric motors draw the heavy trains up one side of the range and by a so-called regenerative braking system, much of the energy used in going up is recovered on the down grade "This is accomplished by reversing the usual function of the electric motors, utilizing the momentum of the train to drive them as generators." (Quoted from "Running Trains with Running Water," published by C M St. P and P Ry) In harmony with our physics text-books, no work is done

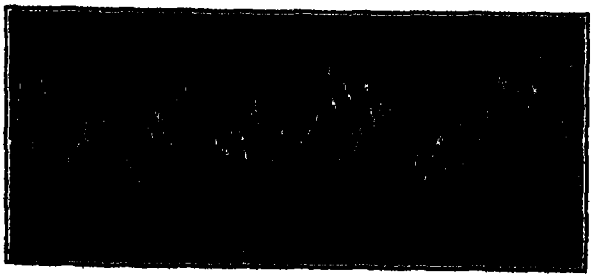


Fig. 1

---

[1] Those who desire measurements and further proof can find them in the writer's article on "Evolution of the Seed Habit in Plants," in the Transactions of the Royal Society of Canada Third series, Vol xxi, 1927, pp. 229–272.

in moving the train over the mountains. Indeed there is much more sense to such a statement than to say no work is done in holding out a mass at arm's length.

In Fig. 1 is shown the way in which the hand carries a kilogram mass at arm's length over an interval of time. The movement is magnified three fold, while the time interval between the vertical and parallel lines is 30 seconds. Involuntarily the arm sinks a short distance, lowering the mass, then the muscles contract and raise it again. Each time the mass is raised work is done, and unlike the Milwaukee system there is no regenerative process on the down slope. Thus from a purely physical standpoint work is being done in holding out a mass and this work must come from an expenditure of muscular energy which produces bodily fatigue.

It will be noted that at the bottom of each downward motion there is a sudden and quick return, making each low point in the movement sharper than those at the top where the beginning of the letting down process seems to be more deliberate.

Any one who carries a load along a level pathway is also unconsciously letting his load fall to be raised a moment later and so doing work. The swinging stride of one walking along a level path also raises and lowers the load carried and again energy is dissipated. The energy which is thus being utilized is not created out of nothing. It must come from bodily exertion and so we experience fatigue.

This relation between bodily fatigue and work could be amplified still more by the physiologist showing how energy is dissipated in the mere tension of the muscles.

S. R. WILLIAMS

FAYERWEATHER LABORATORY
OF PHYSICS,
AMHERST COLLEGE

EFFECTS OF BREED ON EMBRYO SIZE IN THE DOMESTIC FOWL AND THE RABBIT

CASTLE and Gregory[1] have published recently a very ingenious interpretation of Byerly's[2] data on the effects of breed on the growth of the chick embryo. The validity of their interpretation seems to hinge on the soundness of their assumption that the average weight of the unincubated blastoderms in the eggs from Single Comb White Leghorn fowls, 0.0030 gram, is significantly greater than the average weight of the unincubated blastoderms in eggs from Single Comb Rhode Island Red fowls, 0.0028 gram. Byerly judged the difference between these weights to be obviously insignificant and treated his data in accordance with that assumption. Since Castle and Gregory have assumed that the difference in average blastoderm weight is significant, it has seemed necessary to make further measurements of blastoderm weight and to obtain a statistical measure of the variation.

Each blastoderm was washed as free from adherent yolk as possible and transferred to a weighing bottle. Water was removed with a capillary pipette. Some water remained and this accounts for the slightly greater average weights of the blastoderms in the present study than in those described in the writer's former paper[2] for the earlier weights were obtained by weighing several blastoderms at one time. It was possible to remove relatively more of the adherent water in the case of group weighings than in the case of individual weighings. All blastoderms were weighed to the nearest 0.0001 gram.

Twenty-one Single Comb White Leghorn blastoderms had an average weight of 0.00342 ± 0.000181 gram, 22 Single Comb Rhode Island Red blastoderms had an average weight of 0.00333 ± 0.000132 gram. The difference between the average weights, 0.00009 ± 0.000222, is less than half its probable error. Assuming the same variation in the earlier material, the difference between the average blastoderm weights, 0.0002, would be approximately equal to its probable error. Certainly no significance may be attached properly to differences of such magnitude. Byerly[2] was justified, therefore, in his subsequent treatment of his data and therefore in his conclusion that no consistent differences due to breed were present in his data for the first half of the incubation period. Subsequent investigations on growth of the chick embryo make that interpretation still more likely.

Henderson[3] concluded that there are slight, if any, differences in weight of embryos of the same age from matings of Single Comb White Leghorns, of Dark Cornish, and from reciprocal crosses of these breeds. Byerly[4] has shown that a hypothesis that the inherent rate of cell division is the same but that absolute rate of growth under uniform physical conditions of incubation is determined by food supply, is sufficient to account for differences in weight of embryos of the same age in eggs from matings of: Rose Comb Black Bantams; Bantam ♂ × Barred Plymouth Rock ♀; F_1 hybrids from the reciprocal crosses between the Bantams and Plymouth Rocks. The hypothesis is also sufficient to account for embryo size in small eggs, normal-sized eggs, and double-yolked eggs from fowls of breeds which normally produce eggs of standard weight.

Byerly[2] pointed out that different numbers of cells may be present in embryos of the same age, due to different percentages of cells in large and small embryos having been capable of division at any given time in the course of development. Such an effect may be produced at any time during the growing period of the animals by many different sets of conditions, for example, by differences in food supply. Castle and Gregory,[1, 5] and Gregory and Castle[6] maintain that there is an inherent difference in rate of cell division between their large- and small-race rabbits. Such a difference must be present throughout the period of growth of the normal animals.

---

[1] SCIENCE, n. s. 73, June, 1931.

[2] *Jour. Morphol. and Physiol.*, 50, December, 1930.

[3] *Missouri Agri. Exp. Sta. Bul.* 149, Sept., 1930.

[4] *Jour. Exp. Biol.*, in press, 1931.

Gregory and Castle have collected conclusive evidence that large-race-rabbit embryos have more cells than small-race embryos at the 40- and 41-hour stages. However, their data for hybrid embryos between the two races does not rule out the possibility that the difference in cell number at those stages is due to some factor in the environment of the embryo or in the previous history of the egg. Hybrid embryos from a large male and small female mating had significantly fewer cells at 41 hours than large-race embryos of the same age. The difference in average cell number was 2.39 ± 0.568, 4.2 times its probable error. The difference between small-race embryos and those of the hybrids was only 0.62 ± 0.592. This is not a significant difference since it is only slightly greater than its probable error. Therefore, whatever factor inhibited or delayed cell division in the small-race embryos may also have operated on the hybrid embryos from small females and need not have been inherent in the embryos.

In summary, Byerly[2] offered the more probable interpretation of his data. This has been supported by the results of subsequent investigations. Gregory and Castle[6] have not yet precluded the possibility of other interpretations of their own data.

THEODORE C. BYERLY

BUREAU OF ANIMAL INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

OESTRUS-PRODUCING HORMONES

RECENTLY Doisy and his coworkers[1] have reported the isolation from the urine of pregnancy of a crystalline substance possessing oestrus-producing activity, which is distinct from the active substance theelin previously described by them. The latter substance to which they gave the formula $C_{18}H_{21}(OH)_2$ was shortly afterwards isolated by one of us[2, 3] and by Dingemanse and coworkers.[4] It was shown subsequently[5] that this substance is represented by the formula $C_{18}H_{22}O_2$ and that it behaves either as a hydroxy ketone or as a dihydroxy alcohol.

There is no doubt that the second substance isolated by Doisy and his coworkers to which they give the formula $C_{18}H_{21}(OH)_3$ is identical with that fully described earlier by one of us.[6, 7] Although Professor Doisy refers to the triol previously isolated, there is no suggestion in his papers that it had also been characterized as a trihydroxy substance of the formula $C_{18}H_{21}(OH)_3$. His view that the substance described by one of us is a mixture of both active substances is apparently based solely on a difference between the uncorrected melting points. The evidence of the analytical data, which clearly shows this supposition to be untenable, is ignored.

A year ago when the presence in urine of two distinct oestrus-producing substances was clear to us, we were considerably puzzled over the relationship between them. The suggestion was tentatively advanced[7] that the substance $C_{18}H_{22}O_2$, on treatment with hot alkali, took up the elements of water to form $C_{18}H_{24}O_3$. This supposition was subsequently shown to be incorrect,[8] since the former substance proved to be unchanged by such treatment. At the same time it was shown that both substances occur together in urine, and that by distillation in a high vacuum with potassium bisulphate, $C_{18}H_{24}O_3$ could be converted into $C_{18}H_{22}O_2$. Professor Doisy has made no adequate reference to this work and has advanced the earlier view which has been shown to be untenable.

G. F. MARRIAN
A. BUTENANDT

LONDON AND GÖTTINGEN,
JULY 23, 1931

AN ADDITION TO THE HERPETOLOGICAL FAUNA OF KANSAS

A SINGLE specimen of *Bufo punctatus* Baird and Girard was secured in the vicinity of Elkhart, Morton County, Kansas, by W. H. Burt and a party of students from the Museum of Birds and Mammals, University of Kansas, between June 25 and July 5, 1927.

I believe this to be the first record of this species in Kansas. The systematic papers on Kansas herpetology, including the recent "List of Reptiles and Batrachians of Morton County, Kansas,"[1] make no mention of it.

---

[5] *Jour. Morph. and Physiol.*, 48, Sept., 1929.

[6] *Jour. Exp. Zool.*, 59, April, 1931.

[1] Doisy *et al.*, *Proc. Soc. Exp. Biol. Med.*, 28, 88, 1930, *J. Biol. Chem.*, 91: 641, 647, 653, 655, 1931.

[2] A. Butenandt, *Naturwiss.*, 17: 879, 1929.

[3] A. Butenandt, *Deutsch. Med. Woch.*, 55: 2,171, 1929.

[4] Dingemanse *et al.*, *Deutsch. Med. Woch.*, 56, 301, 1930.

[5] A. Butenandt, *Zeit. f. physiol. Chem.*, 191: 140, 1930.

[6] G. F. Marrian, *Chem. and Ind.*, June 20, 1930.

[7] G. F. Marrian, *Biochem. J.*, 24, 1,021, 1930.

[8] A. Butenandt, Abh. d. Ges. d. Wissensch. zu Göttingen, Math. phys. Kl. III Folge, Heft 2, 1931.

[1] E. H. Taylor, *Univ. Kansas Sci. Bull.*, XIX, 6: 63–65, 1929.

Published records of the range of *Bufo punctatus* report it from western Texas to southern California and Lower California[2] It has also been reported from Utah[3] and extreme southwestern Colorado.[4] Ortenburger[5] reports a single specimen from Comanche County, Oklahoma, which seems to have been the northernmost record east of the Continental Divide So it would appear that the known range of *Bufo punctatus* east of the Rocky Mountains has been extended about a hundred miles to the north

Bufo debilis, a near relative, has been recently discovered in the same locality,[6] which makes the occurrence of this species less extraordinary than it would have been otherwise

The measurements of the Kansas specimen (*Kansas Univ Mus Nat Hist*, No 9100) are given below They are quite average for specimens of *punctatus* from Texas and New Mexico

Total length	51 mm
Length of head	11 mm
Width of head	21 mm
Length of hind leg	40 mm
Length of foot	30 mm
Least interorbital width	7 mm
Width of parotoid gland	6 5 mm
Length of parotoid gland	5 5 mm

J Eric Hill

Museum of Birds and Mammals,
University of Kansas

DO PEANUT OR ARACHIS NUT FED HOGS YIELD LARDS CONTAINING ARACHIDIC ACID

Soltsien[1] states that lard from hogs fed on cottonseed meal gives a reaction for cottonseed oil as if 25 per cent of it were present, the milk of cows fed on cottonseed also gives the reaction for the oil[2] In a similar way Sesame oil transmits its familiar color reactions to lard and butter[3]

In as much as the compounds producing the reactions passed unchanged through the animal economy, the question arose as to whether the characteristic glyceryl arachidate of peanut oil would show in lard made from hogs fed on peanuts.

Five hundred grams of lard, obtained from a famous Virginia producer of hams made from peanut-fed hogs, were saponified and treated to obtain arachidic acid by the well-known method of Renaud modified by Tolman[4] The resulting fatty acids were changed to their methyl esters and distilled *in vacuo* Two fractions were obtained, one on recrystallization gave an acid which melted at 61° corresponding to palmitic acid, and another an acid melting at 67°–69° indicating stearic acid No trace of a high boiling methyl arachidate was found

As to the reason for the different behavior of these oils, the color-giving compound in cottonseed oil is thought to be of aldehydic nature, while that in Sesame oil may be phenolic, both of low molecular weight, as compared with glyceryl arachidate (974)

Augustus H Gill
Gordon T Vaala

Massachusetts Institute
of Technology

A MOTOR FOUND IN NATURE

Some time ago, while sitting on the shore of a small lake, my attention was drawn to an object squirming in the water A slender floating reed was turning over and over My curiosity led me to withdraw the reed and to examine it carefully

Apparently the reed had not grown straight but had assumed somewhat a cork-screw shape It was quite accidental that, at the time I happened on the scene, one wave-length of the waves then running closely approximated the axial distance covered by one revolution of the screw-shaped reed. Since the latter was lightly held by obstructions so that it was forced to remain normal to the advancing wave-fronts, each wave, as it moved shorewards, gave the reed one complete revolution

Here was a tiny motor I decided to construct a larger one on the plan taught me by the reed After having determined the dimensions of waves while a brisk wind was blowing on the lake, I gave an inflated five-inch automobile inner tube one turn about a long bamboo pole. (Note The doughnut shaped tube was first cut through opposite the valve and the two ends of the extended tube were then closed) To my delight, the motor, when in the water and anchored normal to the wave fronts, executed continuous rotation as the reed had done. It was interesting to note that, though the sea was rather violent, the motor maintained a constant level and an even keel for the action was that of a screw rather than that of a boat.

Olus J. Stewart

Lexington, Ky.
University of Kentucky,

---

[2] L. Stejneger and T Barbour, "Check List of North American Amphibians and Reptiles," *Harvard Press*, 1923

[3] V. M Tanner, *Copeia* 166 25, 1928

[4] M M Ellis and J Henderson, *Univ Colorado Studies*, 1915

[5] A. I Ortenburger, *Proc Oklahoma Acad Sci.*, 6 92, 1926

[6] E H. Taylor, *loc cit.*

[1] *Z. öffentl*, Ch I, 140, 1901.

[2] J Wauters, *Soc Chem Ind*, 19, 172, 1900

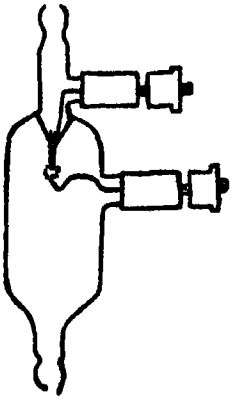
[3] König and Z Schluckebier, *Unt Nahr u Genussm.*, 15, 642, 1908, and also Engel, *Z ang. Chem*, 268, 1906

[4] Gill's "Oil Analysis," p 203

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN IMPROVED DROP RECORDER

WITH reference to the drop recorder described by S. E Owen in SCIENCE[1] It will be noticed that the falling drop has to touch both electrodes in order to function This causes difficulty in adjustment, especially for fast rates If, however, the drop is allowed to run down one wire from the dropping tube it is all the time in contact with one electrode and thus it is relatively much easier to adjust the second electrode for contact A full description of such an instrument was published elsewhere[2] and is also referred to in SCIENCE[3] They are easily made and when once adjusted and used with a decent relay circuit give no trouble and will record over 1,000 drops per minute Owing to the difficulty of drawing a dropping tube sufficiently fine, and at the same time not leaving an outside surface on which a larger drop collects, these instruments are difficult to make above 70 drops per cc, so at the request of Professor Babkin, of McGill University, I slightly redesigned the dropping tube for a higher accuracy (100 drops per cc) This was accomplished by using a short piece of platinum needle for the tip of the dropping tube, where it also serves as one electrode The second electrode is bent up so that the tip touches the lower surface of the forming drop This causes the film to tear and the drop falls off, at the same moment making contact (see sketch) By using bits of the same needle instruments of similar accuracy are readily made, thus rendering the adjustable type previously described (2) more or less unnecessary



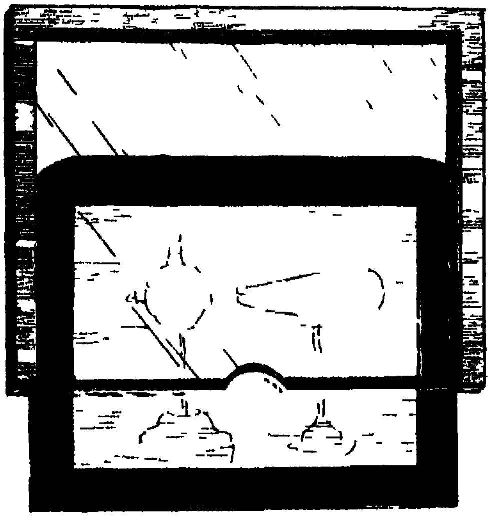
For ordinary purposes, however, the original pattern has proved entirely satisfactory over a wide range of experiments in several laboratories. In the course of my travels I so frequently encounter inventors of "new types" of drop recorders none of which so far present any new characteristics, that, while I have no desire to inhibit research in any direction, I feel that much trouble and time would be saved both to the inventors, and also the users, of many of these instruments if reference were made to my paper in which a study of this quite important practical problem was made

O S GIBBS

LONDON, ENGLAND

FILM LANTERN SLIDES

IN order to overcome the difficulties involved in carrying a large number of lantern slides for use in illustrated lectures, we recently made an attempt to replace the commonly used glass slide by a film slide



Copies of the pictures desired were made on Eastman process film, which lends itself very well to the production of clear slide pictures A specially constructed holder similar to a glass slide was built to hold these films in the projecting lantern This holder consists essentially of two clear glass plates which are sealed together in such a manner as to leave a narrow space between them for the reception of the film Undoubtedly certain refinements can be made in the construction of these holders if they are produced in larger quantities The outside dimensions of the holder are exactly those of the ordinary lantern slide, so that it fits easily into the standard frame of a lantern. The technique of changing the film slides is the same as that of changing ordinary glass slides, except that the glass holder stays in place when the film slides are changed A small, semicircular cut in the top of the holder makes this process easy

The advantages of the film slide over the glass slide are many By the use of film the weight and bulk of a number of slides are reduced to a minimum; breakage is practically nil, since the only breakable part is the holder which can be safely stored in a small box together with the films; notations may be easily made directly on the films Film slides may be stored and filed away in a small space and are therefore more accessible for reference They are easier to make than glass slides and the cost is much less. Larger lantern slides, such as are used in Europe, can be conveniently cut to the size which is used in this country, if films are used

---

[1] S E. Owen, SCIENCE. 74, p. 19, July 3, 1931.

[2] O S. Gibbs, *Jour. of Lab. and Clin. Med*, 1927, XII, p. 686.

[3] O. S. Gibbs, SCIENCE: 69, p. 649, June 21, 1929.

It is probable that the idea of using films for lantern slides is not new, and yet the advantages are so many that it is difficult to understand why the principle is not in general use to-day.

OTTO GLASSER

CLEVELAND CLINIC,
CLEVELAND, OHIO

SPECIAL ARTICLES

ON REFLEX-HYPERLIPAEMIA

PRELIMINARY PAPER[1]

THAT stimulation of an afferent nerve results in a rise of the sugar content of the blood is a well-known fact, nothing, so far as we are aware, is known concerning changes in blood fat under this condition, although perhaps the "emotional" hyperlipaemia, found by Himwich and Fulton, is a related phenomenon

We have, therefore, investigated the changes in blood fat in the cat under stimulation of an afferent nerve The animals in this series were anesthetized by intraperitoneal injection of chloralose At least two hours after the onset of the anesthesia the fat content of the arterial blood was determined (by the method of Stewart and White) before and after periodic faradic stimulation (periods of 5 seconds alternating with periods of rest of 5 seconds) for 2 to 5 minutes at various strengths

In the great majority of the experiments a marked "reflex-hyperlipaemia" occurred, the increase in blood fat is very abrupt, as it was found to be present in the blood drawn immediately after cessation of afferent stimulation

In several instances the rise in fat was greater with stronger stimulation

The following protocol is typical for the experiments of this series

Oct 7, 1931

Cat, female, 3 00 kg, starved for 16 hours

11 00 p m	27 cc 1% (warm) chloralose intraperitoneally
11 10	Animal in side position Rectal temperature 39.0°
Oct 8	
8 00 a m	Respiration regular Temperature 40 3°. Heating off
8 30	Temperature 40 0°
9·00	Animal on board Temperature 39 8° Both femoral arteries and left sciatic exposed.
9 02	First blood drawn (about 9 cc) Respiration 15–16 per minute Hyperreflexia on tapping on board
9 08–9 10	Periodic faradic stimulation of left sciatic (5″–5″) for 2 minutes, coil distance 10 cm Peripheral end of nerve not ligated. Moderate general responses during stimulation periods Dilation of pupils Rectal temperature 39 2° Respiration 15 per minute
9 10	Second blood drawn, about 9 cc
11 30	Temperature 38 6° Hyperreflexia
11. 50	Temperature 40 0°
1 20	Temperature 39 5°
2 04	Third blood drawn (about 9 cc)
2 11–2 13	Stimulation of left sciatic as per 9 08–9 10 (5″–5″, 2 min 10 cm)
2·14	Fourth blood drawn Animal sacrificed

FIGURES

	Hematocrit Per cent	Sugar mg Per cent	Fat mg Per cent	Rise in fat Per cent
1st blood	30	85	396	
2nd blood	34	98	538	35 9
3d blood	34	109	412	
4th blood	32	119	543	31.8

Investigations are in progress to determine whether or not a "center" exists for this reflex-hyperlipaemia, as well as the nature of the fats mobilized.

Y. D KOSKOFF
J. G. DUSSER DE BARENNE

LABORATORY OF NEUROPHYSIOLOGY,
YALE UNIVERSITY

VARIATIONS IN HOLOPEDIUM SPECIES

Holopedium gibberum is a cladoceran species well known to biologists as one of the very few members of the fresh-water plankton which possess a special adaptation to the floating habit in the form of a spherical "test" of a jelly-like substance which encloses the whole body of this small Entomostracan—a feature which is also found in the planktonic Rotifer *Mastigocerca setifera.* To ecologists and to students of animal geography, *H. gibberum* has a still stronger claim to interest in virtue of its characteristic habitat, namely, the slightly acid waters of stenothermous lakes and pools in North America and in northern Europe, and many authorities regard it as a glacial relict. The genus *Holopedium* is no [illegible] interesting to the systematist, since its peculiar structural characters oblige him to place it alone in the family Holopedidae of the cladoceran tribe Ctenopoda, while of this genus itself but two species are known: these are the familiar *Holopedium gibberum* and the little known *H. amazonicum*, described by Stingelin from material collected at the mouth of the Amazon[1] and recorded since then from only one additional locality, namely, Lake Charles, Louisiana.[2] Stingelin himself remarked upon the peculiarity of the fact that this characteristically boreal cold-stenothermous form should have its nearest relative in tropical waters. The circumstance is the more singular from the very close relationship which exists between the two species, and which induced Stingelin to construct a carefully tabulated key to their diagnostic features.[1]

---

[1] The experiments were started by one of us (Y *D* K) during this summer His thanks are due to Mr H Henstell, candidate in medicine of Yale University, for his cooperation during this part of the work

Recently, in examining material collected in certain small lakes near St. Andrew's (New Brunswick), I have found the typical form of the species *H. gibberum* accompanied by forms which show all degrees of variation in respect of these very diagnostic characters used by Stingelin in the separation of the two species.[3] It looks very much as if we have here the beginning of a gradation towards the *amazonicum* type, and it is highly desirable to examine material from as many freshwater lakes and ponds as possible, especially along the eastern fringe of the United States, in order to see whether anything like a true connecting series between the two species can be established. Should this be possible, we should have a case among the Cladocera exactly parallel with that of the two waterbeetles *Deronectes depressus* and *D. elegans*, recently elucidated by Balfour Browne[4] and with that of *Gyrinus natator* and *G. substriatus*, on which another British entomologist is now working.[5] Such north-to-south gradations are of the highest interest in relation to the study of species-evolution and distribution, and it is, therefore, with confidence that I appeal to American biologists for collections of freshwater plankton containing *Holopedium*, especially from the eastern Atlantic States. Such collections can easily be made by towing a plankton-net of bolting cloth from a boat, or even with a hand-net: the catch should be diluted with 4 per cent. formalin containing a few drops of glycerin for efficient preservation. Any specimens sent to me will be gratefully acknowledged and expenses of mailing defrayed.

KATHLEEN E. CARPENTER

WASHINGTON COLLEGE,
CHESTERTOWN, MD.

---

[1] Th. Stingelin, *Revue Suisse de Zoologie*, 12: 53–64, 1904.

[2] E. A. Birge, Chapter on "Cladocera" in Ward & Whipple's "Freshwater Biology," 693, 1918.

[3] An account of these variations is included in a paper on "The Cladoceran Plankton of the Chamcook Lakes," shortly to be published in *Contributions to Canadian Biology*.

[4] F. Balfour Browne, *Scottish Naturalist*, November–December, pp. 172–188, 1930.

[5] J. Omer-Cooper, *Nature*, February 14, 1931.

MANGANESE AND THE GROWTH OF LEMNA MINOR[1]

IT has recently been shown by the author[2] that the unicellular alga Chlorella will not grow without manganese although this organism makes apparently normal growth when only a minute amount of this element is added to the manganese-free culture solution. It has further been demonstrated[3] that a number of other "rare" elements for plant growth are unable to replace manganese in the nutrition of this organism. The results reported on the necessity of manganese for Chlorella are based on determination of the dry weight of cells produced. Since then counts of the numbers of cells in plus and minus manganese cultures have been made. These counts show as high as 64,000,000 cells per culture in some cases in two weeks' time in cultures containing manganese in a concentration of 1:5,000,000. While in minus manganese cultures there is a decrease in the number of cells used for inoculation. This furnishes a striking confirmation of the data already reported. Manganese is therefore not a "stimulant" but an essential element for the growth of Chlorella. Other experiments not yet published using another unicellular green alga (species undetermined) have also shown the same clear cut results as with Chlorella. The investigation was then extended to the common duckweed, *Lemna minor*, and here again it has been found that manganese is indispensable for growth.

Clark and Fly[4] have studied the relation of manganese to Lemna and come to the conclusion that "there is no indication that manganese is an essential element in the nutrition of the plant." Since, however, my work has shown it to be absolutely essential for certain unicellular green algae and others have demonstrated it to be necessary for the normal development of a large number of seed plants it seems plausible that the duckweeds should require it also.

The experiments on *Lemna minor* were all carried out in pure culture. After many trials with various disinfectants the following procedure was successfully used in freeing the fronds from microorganisms. A number of healthy plants were obtained and washed thoroughly with sterile water They were then immersed for an instant, one at a time, in 95 per cent alcohol followed by one minute in $HgCl_2$ solution 1 1,000 and then rinsed in several changes of sterile acid phosphate solution From this the plants were transferred to Knop's solution plus 0 5 per cent of dextrose In this manner six or eight pure cultures were obtained It is suggested that this method may overcome the difficulties mentioned by Saeger[5] in connection with the direct disinfection of the fronds

---

[1] The investigation upon which this article is based was supported by a grant from the Heckscher Foundation for the Advancement of Research established by August Heckscher at Cornell University.

[2] SCIENCE, 72: 609–610, 1930.

[3] E. F. Hopkins, "Manganese an Essential Element for a Green Alga," *Am. Jour. Bot.*, 17: 1047, 1930.

[4] N. A. Clark and C. L. Fly, "The Rôle of Manganese in the Nutrition of Lemna," *Plant Physiology* 5: 241–247, 1930.

Experiments to determine the relation of manganese to the growth of Lemna were made on solutions freed from manganese in two ways In the first case the chemicals used in the preparation of Knop's solution were recrystallized three times from conductivity water In the other case manganese was removed by absorption on calcium phosphate at pH 8 0 as in the work with Chlorella This latter solution which contained dextrose was acidified and its calcium content increased by adding to it a sterile solution of recrystallized calcium nitrate and potassium hydrogen phosphate This procedure was resorted to because of the difficulty encountered in removing manganese from glucose by recrystallization Known amounts of iron (1 500,000) were added to each culture from a solution prepared from recrystallized ferric alum and recrystallized sodium citrate For plus manganese cultures manganese sulphate was added to give a concentration of Mn of 1 5,000,000

In the first experiments without dextrose the controls showed no development of fronds and no root formation while with manganese 1 500,000 there was good development of green fronds and healthy root growth In fact the fronds planted in the control flasks finally became chlorotic and died In table I the results of such an experiment are given

TABLE I

THE NECESSITY OF MANGANESE FOR THE GROWTH OF *Lemna minor* (WITHOUT DEXTROSE)

	Green fronds (54 days)
+ Mn	127 (5 cultures)
− Mn	9 (5 cultures)

In the later experiments the presence of dextrose (0 5 per cent) made it possible to obtain results in a shorter time The summarized data from one of these experiments is given in Table II

The necessity of manganese for Lemna is clearly shown in the above data both with and without iron being added In the latter experiment after the second transfer the plants without manganese showed no development at all and finally died The plants with both iron and manganese were very healthy in appearance with large deep green fronds Those with manganese and without iron were smaller and chlorotic Since the dry weights of the plants agree closely with the counts of the number of fronds these data are not given here An interesting occurrence is the development of definite symptoms of manganese deficiency consisting of depressed root formation and of light brownish to white necrotic areas on the fronds in the case of those cultures without manganese

TABLE II

THE NECESSITY OF MANGANESE FOR THE GROWTH OF *Lemna minor* (WITH DEXTROSE)

Treatment	Per cent increase in no of fronds in 21 days	Per cent increase in 15 days after transferring one plant to another set of culture solutions
− Fe − Mn	222 (5)*	0 (5)
− Fe + Mn	769 (5)	810 (5)
+ Fe − Mn	90 (5)	0 (5)
+ Fe + Mn	843 (5)	1160 (5)

* The figures in parenthesis refer to the number of cultures in each case

I believe that these experiments which have been repeated a number of times with the same result show conclusively that manganese is an essential element for Lemna and suggest that it is undoubtedly necessary for the growth of all green plants

E F HOPKINS

CORNELL UNIVERSITY
LABORATORY OF PLANT PHYSIOLOGY,

BOOKS RECEIVED

BALDWIN, S PRENTISS, HARRY C OBERHOLSER and LEONARD G WORLEY *Measurement of Birds* Pp ix + 165 151 figures Cleveland Museum of Natural History

DARWIN, C G *The New Conceptions of Matter* Pp xi + 224 46 figures Macmillan $3 00

GAMOW, G *Constitution of Atomic Nuclei and Radio activity* Pp viii + 114 Illustrated Oxford University Press $3 50

HAMILTON, JAMES A *Englisch-Deutsch fur Psychologen* Pp 103 Gaul & Bantelmann Frankfurt

HANZAWA, SHOSHIRO *Science Reports of the Tohôku Imperial University* Vol XII. Pp 141 to 194. tion, Washingon.

MACIVER, R. M *Society · Its Structure and Changes.* Pp xvi + 569. Ray Long and R. R Smith $5 00

SCHNARL, KARL. *Vergleichende Embryologie der Angiospermen* Pp vii + 354. Illustrated. Borntraeger, Berlin

SEMPLE, ELLEN C. *Geography of the Mediterranean Region.* Pp ix + 737 14 maps. Illustrated. Holt. $4 00.

WILLS, A P *Vector and Tensor Analysis.* Pp. xxxii + 285 Prentice-Hall $5.00.

---

[5] Albert Saeger, "A Method of Obtaining Pure Cultures of *Spirodella polyrhiza*," *Bull Torrey Bot Club* 57: 117–122, 1930

SCIENCE

VOL. 74 FRIDAY, DECEMBER 4, 1931 No 1927

Some Reflections concerning Valence Variation and Atomic Structure PROFESSOR M. GOMBERG 553

New Concept of Evolution Based upon Researches on the Titanotheres and the Proboscideans DR. HENRY FAIRFIELD OSBORN 557

Scientific Events

Grants from the Elisabeth Thompson Science Fund, The United States Pharmacopoeia, Sigma Pi Sigma Convention, The American Association of Physics Teachers, Annual Meeting of the American Ornithologists' Union, Meeting at the Missouri Botanical Garden in Honor of Julius Sachs, The Thomas Chrowder Chamberlin Science Library 560

Scientific Notes and News 562

Discussion

Gardiner on Coral Reefs · PROFESSOR REGINALD A DALY *Tree Twist* PROFESSOR ARTHUR PAUL JACOT *Marine Tertiary in Arizona* ELDRED D WILSON *The So called Autoxidation of Cysteine* PROFESSOR C A ELVEHJEM 566

Special Articles

A New Mutation in the House Mouse (Mus musculus) DR. ELMER ROBERTS "*At the Top is Magic*" DR. C STUART GAGER 569

The American Association for the Advancement of Science

Mayan Symposia and Exhibits at New Orleans 570

The National Academy of Sciences 571

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N. Y.
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

SOME REFLECTIONS CONCERNING VALENCE VARIATION AND ATOMIC STRUCTURE[1]

By Professor M. GOMBERG
UNIVERSITY OF MICHIGAN

PERMIT me, please, to offer a word of explanation concerning the choice of the subject for this evening's talk. Many years ago it fell to my lot to become interested in a striking instance of valence variation, and the solution of that problem rested wholly on experimental laboratory evidence A number of other similar cases of valence variation have been subsequently encountered by various workers, and their conclusions, also, rested on experimental evidence. Meanwhile, during the last ten years, and especially during these last five years, the theoretical aspect of the entire valence question has received much clarification as a result of certain theories based on the spectroscopic study of the elements. The question is alluring—do the empirical findings, in this branch, of the near past harmonize with the recent theoretical deductions? Obviously, the nature of the reply to this question will be colored to some extent by the psychology of the questioner, but the correctness of the answer can only be in proportion to the requisite technical training possessed by the inquirer On that last score, I bespeak your generous indulgence.

THE KARLSRUHE CONGRESS

To-morrow, September 3, will mark the seventy-first anniversary since the occurrence of the interesting gathering of chemists, in 1860, in the peaceful little city of Karlsruhe, Baden. The delegates came from all countries in Europe, in response to an invitation sent out by a self-appointed committee. Among the 45 signatures attached to the invitation were those of Liebig, Wöhler, Bunsen, Frankland, Williamson, Pasteur, Dumas, but the moving spirit of the organization was young Kekulé. The object of the meeting was to see if by exchange of opinions some reasonable agreement could be reached in regard to the precise definitions of the concepts atom, molecule, equivalent, atomicity, etc. Not all the original signatories to the invitation came to the meeting. Among the some 130 in attendance, Bunsen was present, with the spectroscopic discovery of caesium only a few months old. Dumas, Stas, Marignac, Friedel, Wurtz were there. Of the much younger men, one may mention Roscoe, Wislecenus, Beilstein, Erlenmeyer, and also young Adolph Baeyer, 25, a privat-docent fledgling and eager for some kind of position.

---

[1] Address of the president, the American Chemical Society, Buffalo, N. Y., September, 1931.

It was at the last session of the meeting that Cannizzaro urged upon his hearers the adoption of the long neglected, fifty-year old hypothesis of Avogadro as the only safe guide for differentiating between atom and molecule, as the only safe basis for establishing atomic and molecular weights. Within the next few years Cannizzaro's tables of atomic weights were much in use. This proved to be an important factor in the successful development of the valence hypothesis, since the hypothesis depended for its conclusions upon the relation between equivalent and atomic weight.

VALENCE VARIATION

The question, whether a given element possesses a fixed or variable valence, came at once to the front and continued to serve for many years as a perennial topic of bitter disputes. Kekulé, having been so very successful in his development of structural organic chemistry by attributing to carbon an unvariable valence of 4, made up his mind that all other elements must have each some definitely fixed and unalterable valence. Henceforth he remained committed to this point of view, insisting that valence, like the atomic weight, is an unchangeable attribute of an atom. In order to explain away the existence of such compounds as NH_4Cl or PCl_5, he brought forward his well-known view of molecular compounds. Ammonium chloride, in Kekulé's language, was a combination of the molecule NH_3 and the molecule HCl, held together not in virtue of an increase in the valence capacity on the nitrogen atom from 3 to 5, but in virtue of some kind of attraction betwen the two molecules. This notion of molecular, in distinction from true atomic, combination has been handed down from generation to generation with such slight modifications of meaning as are implied in the terms molecular complex, residual affinity, auxiliary valence, coordination number, etc.

After all, the question of valence variation for one and the same element was but a part of a much deeper mystery. Why do the *various* elements differ among themselves in combining capacity? How far can this difference extend? A partial answer to this query was supplied by the revelation that all properties of the elements, including that of valence, appear to be periodic functions of the atomic weights, repeating themselves after each little group of seven or eight elements, if the elements be arranged in the order of their atomic weights. Biographers like to trace the inception of the Periodic Table, directly or indirectly, to the Karlsruhe meeting in 1860. Be that as it may, both L. Meyer and young Mendeleeff were present at that gathering and both became ardent disciples of Cannizzaro's reforms. It may not be without interest to mention that in his first paper (1869) Mendeleeff did not include valence as a periodically recurring property of the elements, but a year later, in his second and more complete paper, valence appears as the most important periodic function, being successively 1 to 7 for the seven groups, or 1 to 8 if we include also the iron-cobalt group. And ever since, valence has retailed its importance in the periodic classification of elements.

Mendeleeff was aware that he could make valence a strictly periodic property, provided the oxygen derivatives of the elements are considered and not their hydrogen derivatives. In the third period, for instance, we have a clear-cut procession of valence from one to that of seven: Na_2O, MgO, Al_2O_3, SiO_2, P_2O_5, SO_3 and Cl_2O_7. If the valence of these same elements be measured by their hydrogen derivatives—the picture changes. The first three vertical groups in the periodic table give no stable hydrides, the fourth group indicates, again, quadrivalence, but groups V, VI and VII indicate a successively decreasing instead of increasing valence, namely, 3, 2 and 1, as for instance in PH_3, SH_2, ClH. Thus the periodic table in a way confirmed the contention of the earlier chemists that valence of elements can not be considered as fixed, for it seems to vary with the nature of the measuring element, whether the latter be oxygen or hydrogen. Moreover, some of the elements, even in group IV, were known not to be exempt from valence variation towards one and the same element—*i. e.*, titanium forming compounds $TiCl_2$, $TiCl_3$ and $TiCl_4$, tin and lead being di- as well as tetra-valent.

DEFICIENCY VALENCE

Gradually it became tacitly recognized that as a rule the elements do conform to their group position in the periodic table as regards their maximum valence, and then it was further assumed that some elements do not always exercise the full limit of their valence capacity, this being especially the case with the non-metals. The hunt for the possible occurrence of deficiency-valence became a frequent subject for experimentation, and this search extended well into the present century. Thus, the claim has been made repeatedly that sub-oxides with anomalously low valence result when the oxalates of certain metals are heated at 200–300° C. Moissan, in 1899, mentions that metallic calcium reduces calcium di-iodide to calcium monoiodide on fusing together the mixture of the di-iodide and the metal Haber found that barium monochloride resulted from the electrolysis of barium dichloride at 500–600° C Calcium monochloride has been prepared crystalline, and in remarkably pure state, by heating in small bombs the dichloride with metallic calcium to 1,000° and then plunging the bomb into solid CO_2

Carbon, more so than any other element, seemed to possess a fixed valence, tens of thousands of carbon compounds, with carbon functioning always as quadrivalent, offering testimony to that effect When, therefore, it was demonstrated that carbon, also, may on occasions exhibit a deficiency of one valence and function as trivalent, it opened a wide field for search of anomalous valence behavior on the part of other elements As a result, we now know of the existence of compounds which may contain in their molecules either monovalent oxygen, or divalent nitrogen, trivalent lead or tin, monovalent iron, cobalt, nickel or manganese

EXCESS VALENCE

To say that deficiency valence results from non-operativeness of the maximum possible potential valence does not of course explain the phenomenon, but at least it makes it not irreconcilable with the postulates of the periodic system The case, however, is different when we come to consider that large class of complex compounds which result from combination of several whole and completely saturated molecules Take the very simple example, $K[Ag(CN)_2]$ When dissolved in water, dissociation occurs and there are formed the ions K^+ and $[Ag(CN)_2]$—Evidently, the atom of silver in the anion is functioning as if it were divalent Similarly, in $K_2(HgI_4)$, Hg is apparently quadrivalent, in $K_4Fe(CN)_6$ the atom iron is hexavalent In order to obviate, or at least to soften, this discrepancy between valence as ordinarily understood and the peculiarly high valence of the elements in these complex substances, Werner called the latter kind of valence "coordination number."

Obviously, for an adequate explanation of both aspects of valence variation, deficiency and excess, there is required something more than merely the knowledge of the quantitative manifestation of the valence action A knowledge of the nature of the causative agent of valence, and of the mechanism involved in the action of that agent, are essential The disclosures of atomic structure are gradually supplying the knowledge of these two factors.

ATOMIC STRUCTURE

Mendeleeff survived by almost ten years the establishment of the doctrine that the electron is a constituent common to all elements. It would be interesting to learn what was Mendeleeff's reaction to this epochal discovery of Thomson's, since Mendeleeff himself had repeatedly insisted that "the periodic law affords no indication of the unity of matter or of the compound character of the elements" What a striking change in our cosmic views in so short a period! That all matter is electric in its nature is now a fundamental tenet in modern science

The Rutherford-Bohr planetary atom, with its positively charged nucleus surrounded by the negatively charged electrons, has reached, as you know, that astounding stage of development when one may speak of the structure of the atom with a reasonable degree of confidence Still, for one whose detailed knowledge of the subject is not of that extent when familiarity with the subject shields one against surprises, for such a person there is something terrifying in the boldness of the statement, however well founded it may be, that a single atom of mercury consists of 400 individual units, and that its 200 electrons can be arranged into at least 15 groups in accordance with their respective specific functions in the atom in its normal state Still more astounding is the statement that in a single atom two electrons can never coincide in all their energy relations to the atom

This is not the occasion to undertake a detailed account of the theories of atomic structure, and I am certainly not the person qualified to undertake the task In presenting the following few remarks I shall endeavor to observe Mr Sidgwick's sound advice to the chemist—"not to use the terminology of physics unless he is prepared to recognize its laws"

Basing their deductions upon the study of the manifold series of lines in the optical and the x-ray emission spectra of the elements, and in order to account for these series, the spectroscopists have concluded that the electrons which surround the nucleus can be classed into several principal groups in accordance with their respective energy content We can imagine, with Bohr, that as the number of the planatory electrons, in the heavier atoms, becomes larger, they arrange themselves in concentric shells around the nucleus, each shell being characterized by its own energy level The first horizontal series, hydrogen to helium, has one shell, and each succeeding series—whether the series be long or short—acquires an additional shell.

VALENCE ELECTRONS AND VALENCE ACTION

Much detailed knowledge is at hand concerning the exact number and disposition of the electrons in the individual inner shells The chemist, however, is interested mainly in the outermost electrons, for these alone are affected in chemical reactions between atoms. The elements in the first vertical group of the Mendeleeff-Moseley periodic table are monovalent and contain each one valence electron, the divalent elements in the second group contain 2 such electrons, etc. The inert gases in the eighth group are zero-valent, and are supposed to owe their stability and inertness to the presence of 8 electrons in exterior shell. It is one of the unsolved mysteries—or one of the arbitrary postulates, as you wish—that an exterior shell, no matter how many other shells happen to interpose between it and the nucleus, becomes stabilized by the presence of 8 electrons, while shells three and four, counting from the nucleus, may contain, and for full stabilization actually require, 18 and 32 electrons, respectively The great acumen with which G N Lewis and also I. Langmuir, two pioneers in this field, have expounded this theory of a stable 8-electron shell, and also the application of this theory to molecular structure, is recent history to all of us

It is customary to distinguish three kinds of valence action (1) *When each of the two combining atoms* contributes a valence electron and the bond consists in the two atoms sharing the pair of electrons This conception is almost identical with the original notion of the bond as has been used in organic chemistry since the days of Kekulé, except that the idea is now put in modern nomenclature. Such a bond is said to be *non-polar or co-valent* (2) *An atom may be* completely robbed of one of its valence electrons, and so becomes a positively charged ion, (we may call this a positive valence) (3) The atom may gain an electron from some other atom, and become a negatively charged ion, (this we may designate as a negative valence) The last two modes of valence action are generally grouped together as electro-valence, since they both result in the establishment of a polar bond, *i.e.*, the two oppositely charged ions being held in loose combination through electrostatic attraction. However, for the purposes of the present discussion it seems preferable to class all three modes of valence operation into one group, *i e*, the so-called electro-valence bond involves also the participation of a valence electron from each of the atoms that are held by the electro-static attraction A word of explanation seems necessary. For some time I have been a slave to the idea that an electro-valence bond is a secondary, and never a primary result of valence action The primary phase consists always in the establishment of a pair of shared electrons between two atoms, one electron from each participating atom Whether the bond remains as so formed, or whether the pair of electrons will shift wholly to one of these two atoms—impoverishing the one and enriching the second atom by one electron—is a matter which depends upon the relative sizes of the nuclei of the two atoms, and upon many other circumstances. For instance, hydrogen chloride, liquefied, is not an electrolyte, and hence the bond is non-polar; but when dissolved in water, the bond becomes polar and dissociation is almost complete. Many analogous instances may be cited—and one is not wholly unjustified in making the generalization that all bonds are, in their primary phase, non-polar, requiring from each of the two atoms one electron, the two electrons being "corresponding electrons (London, Heitler). The remarks which follow refer therefore to the non-polar, as well as to the primary phase of the electro-valent bond.

DISTRIBUTION OF VALENCE ELECTRONS

Now, there is abundant spectroscopic evidence that the valence electrons are not limited exclusively to the very outermost shell alone This is particularly true of the elements with atomic weight of 45 and above, and the atoms of which have more than 3 shells. There are almost 20 elements, the valence electrons of which must be considered as distributed, part being in *the outer shell and some in the next underlying shell.* Moreover, in some rare earths, the distribution of the valence electrons occurs into 3 shells It stands to reason that elements of this kind must exhibit variable valence In some chemical reactions the electrons in the outer shell alone may be induced into action, while under other different circumstances valence electrons in the underlying shell as well may become detachable, and thus may also become operative as valence electrons Such elements are Sc, Ti, Cr, Mn, etc. These elements are well known for their multiple valence.

However, even in those elements where the valence electrons are all contained in the outermost shell only, occurrence of variable valence is still consistent with atomic structure theories Spectroscopic evidence indicates that the electrons in the outer shell, on the basis of their energy content, fall into two subgroups, 2 electrons in the first subgroup, and the remaining, from 1 to 6, as the case may be, fall into the second subgroup. It is conceivable that, beginning with the third vertical group, where the elements have each three valence electrons, either all three valence electrons in the atom may become operative, or only those that belong to one of the two subgroups, according to particular conditions of chemical reaction. The finding of the still unknown AlCl or $AlCl_2$, in addition to the well-known compound $AlCl_3$, should occasion no great surprise, since the three valence electrons in aluminium are not all in the same subgroup. Indeed, beginning with the fourth vertical group in the periodic table, such variation is known to be rather the rule than the exception, and this behavior is quite in agreement with the postulate of the theory, since the valence electrons, although all in the exterior shell, are distributed among two sub-classes as 2.2, 2.3, 2.4, 2.5, in IV,V, VI, VII periodic groups respectively. Thus, we have $PbCl_2$ as well as $PbCl_4$; PCl_3, PCl_5; SCl_2, SCl_4, SF_6, etc. Of course, not all periodic-variations in molecular composition have as yet been realized. For some of these compounds, at the present time still hypothetical, theoretical considerations predict an endothermal and unstable state, other compounds, even if predicted to be thermodynamically stable, are likely to prove less stable than analogous products into which they can readily transform. Thus, AlCl is probably an exothermic compound and should exist, were it not for the fact that $AlCl_3$ is decidedly more stable, consequently, there is a tendency for the following reaction to occur spontaneously: $3\ AlCl = 2\ Al + AlCl_3$

Thus, the manifestation of valence variation appears explainable in the case of such atoms which have their valence electrons distributed among 2 or 3 shells, explainable also in the case of atoms the valence electrons of which are all located in one shell, but the number of these electrons is more than 2. But how do the following instances of valence variation find their explanation (1) In the second group metals—Mg, Ca, Sr, etc.—the two valence electrons are both in the same shell and both belong to the same subgroup, therefore, both electrons may be expected to enter into the formation of a bond with equal ease and therefore simultaneously. And yet we know, as cited in the early part of the paper, under certain conditions this is not the case. (2) Carbon, with its 4 electrons as 2 2, may be expected to function as bivalent and quadrivalent—but why trivalent? Similarly, why oxygen-univalent? (3) Why in chlorine, is valence variation by two—1, 3, 5, 7? How to explain the fact that fluorine, a member of the same group with chlorine, is always univalent, and no more?

You would not wish me to enter here upon the discussion of these and other similar questions. May I merely say that, in my judgment, no one can fail to be impressed by the cogency of the arguments which London, Heitler and others have built up during the last three or four years, on the basis of what is known as Pauli's Exclusion Principle. All the above-mentioned valence variations seem to be explainable in a satisfactory manner.

The above few illustrations may suffice to show that modern atomic structure theories are of great assistance to the chemist in explaining valence variation. What used to be a purely empirical fact becomes in the light of these theories an understandable concrete process. The occurrence of compounds with monovalent calcium or magnesium, divalent aluminum, trivalent carbon, and other cases of deficiency valence are not only compatible with these modern theories, but are predictable on the basis of the theories. The situation is not quite so satisfactory when we come to consider the coordination compounds, wherein elements exhibit what looks like excess valence. Nearly all attempts at explanation of these cases of valence variation make wide use of hypotheses, which in themselves may be legitimate and are plausible, but they do not rest on sufficiently clear-cut experimental evidence. It is not surprising, therefore, that two such eminent authorities as Sidgwick and Sugden do not agree whether a non-polar bond always requires for sharing a pair of electrons or whether a single electron will suffice, whether an octet of electrons around an atom is the limit, or whether ten, twelve and more electrons are also possible. The fundamental theory, however, of atomic structure is sound, and we may rest assured that these problems will in time also be solved.

CONCLUSION

In bringing to a conclusion these few scattered reflections concerning valence variation and atomic structure, may I be permitted to say this. He who is experimentally inclined may henceforth take heart and he need not be quite so timid in interpreting strange chemical reactions on the assumption of possible anomaly in the valence of the reactants. The physicist has no hesitation in speaking of the temporary existence, at the higher temperature employed in spectroscopic work, of such molecules as BaCl, AlO, (HO), CH^+, CH_2, MgF, etc. Is it not possible that under the influence of surface forces somewhat similar valence variation may not be excluded even at lower temperatures? That these strange compounds are thermodynamically unstable may be true. Nevertheless, they may function as the mysterious catalysts, or as initiators of chain reactions.

NEW CONCEPT OF EVOLUTION BASED UPON RESEARCHES ON THE TITANOTHERES AND THE PROBOSCIDEANS[1]

By Dr. HENRY FAIRFIELD OSBORN
PRESIDENT OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE new concept of evolution is not to be confused for a moment with the pre-observational "entelechy" of Aristotle, the "vitalism" of Driesch, the "évolution créatrice" of Bergson, the "emergence" of Lloyd-Morgan, the "holism" of Smuts, or any other of the age-long "internal-perfecting" hypotheses which are more or less metaphysical anticipations of the order of nature It is, on the contrary, purely inductive or post-observational

---

[1] This is the seventh paper on the Origin of Species, and the newer aspects of the Evolution problem. The National Academy of Sciences, November 16, 1931.

The new concept is based on thousands if not hundreds of thousands of observations on invertebrate and vertebrate fossils The mammals for the first time reveal the complete life history of a great hoofed family, the Titanotheres, during twelve million years, of a great hoofed order, the Proboscideans, during thirty million years, gathered from all the museums and all the countries of the world The anatomical contrasts between these two groups of animals, namely, the arrest of tooth evolution in one and the marvelous progress of tooth evolution in the other, serve to absolutely establish the nine new principles of paleontology revealed since 1869[2]

Recently the grinding teeth of the Proboscideans enable us for the first time to establish the rate of evolution in an extremely important adaptive organ, very slow even in the course of ten thousand years This incredibly slow rate exposes the futility of modern experimental research which would produce a new character in a single year or in a few seconds

In brief, the new concept of evolution is forced upon us by the discovery since the year 1869 of nine new principles of biomechanical evolution which were not only unknown to Charles Darwin but are antagonistic to one of his fundamental theses that Nature does anything by variation, by fortuity, by accident or by chance It has taken sixty-two years of observation, namely since Waagen's observation of 1869, to demonstrate that organic like inorganic Nature does nothing by accident or by chance but only by means of universally prevailing adaptive principles which are only revealed in long secular periods of time The very words adaptive action, reaction and interaction imply a chasm between biomechanism and inorganic mechanism, across which there is no bridge at present

Moreover, as the principal point of the present address, we are compelled to return to a creational concept of evolution Mark that the word *creational* is used without any of its old theological or philosophical implications, it is clearly distinct from the word *created,* there is no equivalent in the Greek language For this concept the term "aristogenesis" is provisionally suggested until the classicists can furnish us with a single term signifying the *creative origin of the adaptive*

A brief survey of the twenty-five centuries of observation and induction brings us face to face with this new concept

DARWIN THE FOUNDER OF PALEONTOLOGY

After its brilliant inception by Cuvier at the close of the 18th century, paleontology lapsed during the first half of the 19th century into a merely descriptive and systematic science on the Continent and even in Britain under the genius of Hugh Falconer and Richard Owen Despite great discoveries in India, Australia, South America and Europe, paleontology lacked any central principle, its philosophical potentialities were never released Falconer and Leidy, who opened up the ancient fauna of the Siwaliks of India and of western America and who recognized ancestral affinities in the Proboscideans, horses and other mammals, spoke guardedly of descent because there was a hush on the old concept of evolution It was Darwin, the disciple of Lyell and the observer of South American Pampean fossils, who reanimated this slumbering giant of Biology, and created modern paleontology, which reveals the life history of the earth's billion years, and furnishes the only absolutely incontrovertible proof for Darwin's "Origin of Species" and "Descent of Man"

Darwin worked altogether on the old variational concept, he lived too soon to see the fruits of the evolutionary paleontology, which he founded Not a single *phylum* or actual line of descent, not an ascending or descending mutation, not a single specific origin, not a single character origin was known to Darwin In invertebrate lines of descent Waagen (1869) led the way to the new concept of evolution closely followed by Neumayr, and Alpheus Hyatt. Among the vertebrates, Leidy, Cope, Marsh, Gaudry were the pathfinders of phylogeny and of continuous lines of ascent But the pioneer in the Darwinian revolution was Waldemar Kowalevsky, the first to apply Darwin's survival of the fittest idea to single adaptive or inadaptive organs

Among the *older hypotheses as to the modes of evolution or organs* paleontology proves that Lamarck was wrong in his main assumption that characters acquired by the soma are inherited, Darwin was wrong in adding Lamarckism to his original selection theory. Paleontology also reveals the fallacy in McBride's recent Lamarckian argument that habit is a driving factor in evolution, habit is not the driving factor but it is one of the guiding factors, grant the whole arguments of the Lamarckians, ancient and modern, the larger part of biomechanical evolution would still remain unaccounted for Darwin knew not a single one of the nine paleontologic principles discovered since his time DeVries was wrong in believing that species arise by the selection of fortuitous mutations. Darwin passed away just at the time when Weismann was establishing his cellular continuity of the germ-plasm principle, Weismann was wrong in his subsidiary super-selection assumption that fortuitous variations of the germ-plasm give rise to new species Darwin recognized the sub-species of birds and tortoises on the Galapagos Islands produced by geographic isolation, but he lived too soon to recognize Wagner's now well established principle of the origin of species and sub-species through geographic isolation Darwin was doubtful of Buffon's factor of speciation through the direct action of environment, he was astonished at the pioneer case of *Saturnia* brought forward by Wagner Darwin knew not a single case of intergradations between living species, we now know hundreds of intergradations in fishes, birds, reptiles and mammals

---

[2] These nine principles are set forth in the British Association Centenary Address, September 25, 1931, to be printed in *The American Naturalist,* January–February, 1932

As to the older hypotheses as to the origin of single characters, throughout Darwin's life period our attention was mainly concentrated on species rather than on single characters In this after-period both zoologists and paleontologists are concentrating on the origin of single characters of which sub-species, species, genera and orders are by-products Understand the origin, rise and fall of a single adaptive biomechanical character and you will understand the whole story It is like Tennyson's "flower in the crannied wall"

In conversation with Dr Hans Spemann recently, and knowing of his brilliant researches upon "living organizers," I asked him to produce a system of fossil organizers by which the nine new principles revealed by paleontology could be coordinated He declared himself an agnostic as to the causes of evolution I also am a complete agnostic, perhaps even more of an agnostic than Spemann, because, while he may be familiar with the eleven principles of biomechanical evolution revealed by zoology and comparative anatomy, we have through forty years of continuous observation become familiar with nine additional principles revealed by paleontology

It does not detract one iota from Darwin's greatness as the founder of modern paleontology to say that it revolutionizes Darwin's old variational concept of the evolution process, even as Cuvier's paleontology of special-creation and successive-creation concepts was revolutionized by Darwin. Would that Darwin could return to earth to see his fossil offspring and to welcome the new concepts revealed in the extinct animal and plant kingdoms and of man

SIX PRINCIPLES OF THE NEW CONCEPT

Certain of these six principles of biomechanical evolution were presented in the author's Hale Lectures before the National Academy in the year 1916, subsequently published in a volume entitled "The Origin and Evolution of Life" Others are here stated for the first time.

(1) *Uniformitarian rather than cataclysmal.*

Organic evolution conforms with the uniformitarian interpretations of Hutton and Lyell of the middle of the 18th century which had such a profound influence on the mind of Darwin The uniformity of organic evolution proceeds with the uniformity of the physical and chemical environment

(2) *Centrifugal rather than centripetal*

Paleontology strengthens Weismann's epoch-making generalization of 1880, namely of the geneplasmic rather than somatic origin of all characters. No characters arise except from latent potentialities in the germ

(3) *Creational rather than variational*

Paleontology adds something far more important, namely, the adaptive origins of new characters from the germ for which the only term in our language at present is "creational" Paleontology strengthens the conclusions independently reached by zoologists that Darwin, from lack of evidence in his time, overstressed the principle of variation Paleontology, moreover, demonstrates that variation of *kind* is temporary and fugitive, although plus and minus variation of *degree* is very important under selection

(4) *Reactional rather than entelechistic*

This creational process is, however, not wholly spontaneous, independent or emergent except perhaps in the evolution of the mind The latent biomechanical powers of the germ are only evoked in the process of adaptive reaction either in the course of individual development or as a secular or age-long process

(5) *Anti-energistic rather than syn-energistic*

Life tends to borrow energy in order to resist energy—this is the distinctive feature of all living mechanisms—the root of the idea of the struggle for existence

(6) *Evolution is proi-empirical rather than meta-empirical*

Many of the biomechanical organs evolve in the geneplasm before there is any actual need for them rather than after the need for them arises This is in opposition to the main thesis of Lamarck and of Herbert Spencer. Spencer believed that mind was built up through experience, but observed facts prove otherwise We have found that much larger intelligence exists among primitive people than there is any actual need for, intelligence capable of grasping mathematical concepts among Eskimos who had no need even to count on their fingers.

SCIENTIFIC EVENTS

GRANTS FROM THE ELIZABETH THOMPSON SCIENCE FUND

PREVIOUS awards from the Elizabeth Thompson Science Fund were reported in SCIENCE on November 15, 1929, and earlier Since the last report the following awards have been made

At the meeting of December 3, 1929

Margaret Harwood, Maria Mitchell Observatory, Nantucket, $300 for assistance in the measurement of the light of variable stars and the computation of the periods of variation

At the meeting of February 11, 1930

R A Brink, University of Wisconsin, $300 for assistance in the classification of pedigreed maize cultures segregating for a condition known as semi sterility

J E Hull, Belford Vicarage, Northumberland, $150 for the purchase of a microscope to aid in his studies of the acarina

Arthur Jacot, Shantung Christian University, $120 toward aid in carrying on researches on moss mite fauna and on mullets

R L Taylor, Bar Harbor, Maine, $100 toward the compilation of an alphabetical list and bibliography of the parasitic hymenoptera.

W S Cooper, University of Minnesota, $350 for aid in physiographic and vegetational investigation of the early post glacial sand dunes of the Mississippi Valley in Minnesota

L O Overholts, Pennsylvania State College, $150 for assistance in completing a monograph on the polyporaceae of the United States and Canada

H C Heath, Woman's College of Alabama, $300 for aid in experiments in the use of potash shale as a soil builder

At the meeting of November 24, 1930

H J Deuel, Jr, University of Southern California, $300 for investigations on the antiketogenic value of various carbohydrates

Arthur Jacot, Shantung Christian University, $200 for aid in duplicating two early collections (now lost) of moss mites

F W Emerson, New Mexico Normal University, $50 for equipment to study the distribution and means of propagation of the scrub oak and conifer association.

At the meeting of February 28, 1931

William Rowan, University of Alberta, $400 toward the expenses of his experiments on migratory habits of birds

At the meeting of May 26, 1931

Gerhard Kirsch and Friedrich Hecht, of Vienna, $250 to procure a microbalance for special analysis of radioactive minerals with reference to the better determination of the age of the earth.

P B Babkin, McGill University, $300 for assistance in experimental investigations on the relation of the gastric secretion to pernicious anemia.

At the meeting of November 24, 1931

W H Horr, University of Kansas, $100 for the purchase of certain sugars for the further study of the nutrition of fungi

The trustees of the Elizabeth Thompson Science Fund meet ordinarily during the last ten days of the months of February, May and November Applications for grants should be sent well in advance of the meeting to the secretary of the fund, Dr. Edwin B. Wilson, 55 Van Dyke St, Boston, Mass

THE UNITED STATES PHARMACOPOEIA

E FULLERTON COOK, PH M, Philadelphia, Pa., is chairman of the Committee of Revision of the Pharmacopoeia of the United States of America, 1930–1940

The chairmen of the sub-committees working on the eleventh revision of the Pharmacopoeia are as follows

Reid Hunt, M D, of Boston, Mass, Sub Committee on Scope

H A Christian, M D, of Boston, Mass, Sub-Committee on Therapeutics and Pharmacodynamics

C W Edmunds, M D, of Ann Arbor, Mich, Sub-Committee on Biological Assays

G W McCoy, M D, of Washington, D C, Sub Committee on Biological Products and Diagnostical Tests

E L Newcomb, Ph M, of New York City, Sub Committee on Botany and Pharmacognosy

C B Jordan, M S, of West LaFayette, Indiana, Sub Committee on Proximate Assays.

John C Krantz, Jr, Ph.D., of Baltimore, Md, Sub-Committee on Inorganic Chemicals

G D Beal, Ph D, of Pittsburgh, Pa, Sub-Committee on Organic Chemicals

Ernest Little, Ph D, of Newark, N J, Sub-Committee on Reagents and Test Solutions

Charles H LaWall, Sc D, of Philadelphia, Pa., Sub-Committee on Volatile Oils

W L. Scoville, Sc D., of Detroit, Mich, Sub-Committee on Extracts, Fluidextracts and Tinctures.

H A Langenhan, Ph D, of Seattle, Wash., Sub Committee on Waters, Solutions, Spirits, Syrups, Elixirs.

Leonard A Seltzer, Sc D., of Detroit, Mich., Sub-Committee on Cerates, Ointments and Miscellaneous Galenicals.

Theodore J Bradley, Phm.D, of Boston, Mass., Sub-Committee on Tables, Weights and Measures.

A G DuMez, Ph D, of Baltimore, Md., Sub-Committee on Nomenclature.

SIGMA PI SIGMA CONVENTION

THE national convention of Sigma Pi Sigma, honorary physics fraternity, was held at the University of Kentucky from November 5 to 7. National officers, delegates from the twenty chapters and alumni members gathered at 7:30 P M. on November 5 at the Lafayette Hotel in Lexington for a model initiation of pledges from the Kentucky chapter, the pre-convention smoker and a meeting of the executive council of the society. Formal sessions of the convention began at 9 00 A. M on November 6, with an address of welcome by Professor Wm S Webb, head of the department of physics of the University of Kentucky Dr R C Young, of the College of William and Mary, then delivered his address as retiring president on "Recent Advances in Physics in their Relations to Other Sciences"

The report of the secretary, Dr Marsh W White, of the Pennsylvania State College, indicated a substantial development of interest in the idea of a national honorary physics fraternity, as evidenced by the chartering of fourteen new chapters since the previous convention in 1928 and a growth in membership to more than 700 Among the new chapters scheduled for installation is one at the University of the Philippines. The secretary reported the beginning in 1930 of the publication of a magazine, *The Radiations of Sigma Pi Sigma* and an esoteric publication, *The Bulletin* Each chapter delegate also presented a report of the activities of his group, showing that open meetings of the chapters during 1930–31 have been addressed by such speakers as R A Millikan, K T Compton, W E Forsythe, Arthur Haas (University of Vienna), D. C Miller, F K Richtmyer, C E Mendenhall, etc

The guest speaker at the convention was Dr W F G. Swann, director of the Bartol Research Foundation He was initiated into the fraternity as an honorary member, after which he spoke on "Electrodynamics and Relativity" His evening address to a large audience was on "Some Philosophical Concepts of Modern Physics."

At the business sessions on November 7 plans were devised for nation-wide tours of prominent physicists as speakers to the chapters of the fraternity and at neighboring institutions Officers elected were *President*, Dr M N. States, Central Scientific Company, *Vice-president*, Professor G. D Collins, Duke University, and *Executive Secretary*, Dr Marsh W White, the Pennsylvania State College The additional members of the *Executive Council* are. Dr R. C Young, College of William and Mary; Dr R. C Colwell, West Virginia University; R. W. Graves, Duke University, and Dr. J. M. Douglas, Davidson College.

THE AMERICAN ASSOCIATION OF PHYSICS TEACHERS

The second annual meeting of the American Association of Physics Teachers will be held on December 30 and 31 in New Orleans in conjunction with the annual meeting of the American Association for the Advancement of Science, with which this association is affiliated. Headquarters has been established at the Hotel Roosevelt

On Wednesday, December 30, at 6 30 P. M., the association will meet with the American Physical Society at a joint dinner at the Hotel Roosevelt.

On Thursday, December 31, at 10 00 A M, the association will meet in Room E, Hotel Roosevelt, and the program will consist of a list of invited papers dealing with various phases of the most recent developments in the teaching of physics

The afternoon program at 2 00 P M will consist of a number of short papers given by members of the association, dealing with special pieces of laboratory and demonstration apparatus of recent development by the authors Some of this new apparatus and others not discussed in these papers will be on exhibition in the general apparatus exhibit of the American Association for the Advancement of Science in the Municipal Auditorium.

At 4 00 P M on Thursday, December 31, there will be the annual meeting for election of officers and transaction of business

The detailed program of the various sessions may be obtained previous to the meeting by writing to the secretary of the association, Professor Wm. S Webb, University of Kentucky, Lexington, Kentucky

THE ANNUAL MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

The Forty-ninth Stated Meeting of the American Ornithologists' Union was held in Detroit, Michigan, from October 19 to 23, 1931 The meeting was largely attended and representatives were present from 21 states and 5 provinces The headquarters were at the Book-Cadillac Hotel where the business sessions and most of the public sessions were held. On Wednesday the meetings were held at Ann Arbor, in the Museum of Zoology of the University of Michigan, and on Thursday afternoon the closing session was held at the Cranbrook Institute of Science at Bloomfield Hills.

The officers were reelected for 1932 as follows: *President*, Joseph Grinnell, Berkeley, California; *Vice-presidents*, A C. Bent, Taunton, Massachusetts; J H. Fleming, Toronto, *Secretary*, T S Palmer, Washington, D. C, *Treasurer*, W. L. McAtee, Washington, D. C. Additional members of the council, James P. Chapin, Ruthven Deane, H C Oberholser, J L. Peters, C. W Richmond, T. S Roberts and P. A. Taverner.

The election of new members included three corresponding fellows: Albert Collin, of Helsinki, Finland, M B Kinnear, of London, and Ernst Mayr, of Berlin

Five members elected were Clinton G Abbott, San Diego, O L Austin, Jr, North Eastham, Massachusetts, W W Bowen, Philadelphia, B H Christy, Sewickley, Pennsylvania, and Mrs M M Nice, Columbus

The Brewster Medal, awarded biennially for the most meritorious work on American birds, was awarded this year to Mrs Florence Merriam Bailey for her "Birds of New Mexico"

On Friday, October 23, the members visited the Jack Miner Sanctuary, at Kingsville, Ontario, and after luncheon proceeded to Point Pelee National Park, where the afternoon was spent in observing the birds

MEETING AT THE MISSOURI BOTANICAL GARDEN IN HONOR OF JULIUS SACHS

ACCORDING to a statement issued by Dr George T Moore, director of the Missouri Botanical Garden, the one hundredth anniversary of the birth of Julius Sachs occurs October 2, 1932 In view of the proximity of this date to the meeting of the American Association for the Advancement of Science in New Orleans, it seems suitable that some recognition be given to this anniversary during the holidays Accordingly, the Missouri Botanical Garden is planning to keep "open house" on Sunday, December 27, for botanists who are planning to attend the meetings at New Orleans

Guides will be on hand for the outside gardens and conservatories, and will leave the main gate at Tower Grove Avenue and Flora Place on the hour from 9 A. M until 12 noon The library and herbarium will be open during the morning and members of the staff will be in attendance to furnish information or assistance There will be a special exhibit of books of historical interest relating to the development of plant physiology Luncheon will be served in the conference room of the administration building at 1 P M

There will be a program of scientific papers in the lecture hall of the old museum building at 2 P M

"Plant Physiology as Sachs Found It," by Dr Ernest S Reynolds, Washington University

"The Contributions of Sachs to Plant Physiology," by Dr Charles F Hottes, University of Illinois

"Progress in Plant Physiology since Sachs," by Dr. D. T MacDougal, Carnegie Institution.

The best train for New Orleans leaves at 6 30 P M, Sunday, arriving at New Orleans at 6 P M, Monday. The program will be completed in ample time to admit of taking this train Tickets can be purchased from St Louis to New Orleans over the Missouri Pacific Railroad A representative of the railroad will be at the garden to arrange sleeping car reservations, for which ample space will be reserved

THE THOMAS CHROWDER CHAMBERLIN SCIENCE LIBRARY

ON October 20 Beloit College dedicated a new science library to the memory of Dr Thomas Chrowder Chamberlin, graduate of Beloit College in 1866 and later a member of the faculty This library has been built around Dr Chamberlin's private library which was given to Beloit by Dr Rollin T Chamberlin in 1930 and has been named the Thomas Chrowder Chamberlin Science Library. Professor Chamberlin also sent $1,000 to supplement this collection of books in the field of geology

The disposal of this gift brought home to the college the advantages which might be obtained by organizing a science library to be housed in the Pearsons Hall of Science, and to be administered as a branch of the Beloit College Library Through the kindness of the heirs of the late William E Hale, a gift of $11,404 was used for the reconstruction of the small auditorium in Pearsons Hall of Science, the sloping floor being replaced with a cement floor and the entire surrounding brick walls being made more nearly fireproof The basement below was walled up and the construction was so carried out that the lifting of a cement slab will later, with the growth of the library, make possible an extension of stacks into the lower floor In the reconstruction, a modern double sky-light was installed and ventilation was secured through the installation of several univent units. Library equipment, including approved metal stacks, attractive oak tables and Windsor chairs, suitable periodical and display book racks, with complete card index files, have been secured

The library already contains 13,000 volumes. It makes possible an ideal relation between laboratories and reference books through its nearness to the various scientific laboratories.

SCIENTIFIC NOTES AND NEWS

THE Penrose Medal of the Geological Society of America, given for outstanding service in the advancement of geological science, has been awarded to Dr William Morris Davis, professor emeritus of geology of Harvard University. Presentation will be made on December 30 at the annual dinner of the society to be held in Tulsa in connection with the forty-fourth annual meeting. The medal was founded in 1926 by the late Dr R A F. Penrose, Jr

THE Rockefeller Institute for Medical Research on November 20 honored Dr Theobald Smith, member emeritus of the institute and vice-president of its board of scientific directors, at a dinner which was held at the department of animal and plant pathology near Princeton, New Jersey The dinner marked the formal opening of the Theobald Smith House, which was for many years the residence of Dr and Mrs Smith while he served as the director of the department and has recently been remodeled to serve as a staff house for the scientific workers Dr Simon Flexner, director of the Rockefeller Institute, presided In addition to Dr Theobald Smith, speeches were made by Mr John D Rockefeller, Jr, and Dr William H Welch

DR WILLIAM KELTNER ROBBINS, known for his work on textile coloring, died at Manchester, N H, on November 26, aged seventy-six years Dr Robbins was chief chemist of the Amoskeag Manufacturing Company

DR GEORGE WILLIAM MYERS, professor of the teaching of mathematics and astronomy at the College of Education of the University of Chicago from 1901 until 1929, died on November 23 at the age of sixty-seven years

THE death in the Crimea, near the Nikitsky Gardens, is announced of Dr S Kostychev, known as an authority in plant physiology

MAJOR GENERAL SIR DAVID BRUCE, distinguished for his work on tropical diseases, president of the British Association for the last Toronto meeting, died on November 27 at the age of seventy-six years

MEDALS of the Royal Society were awarded at the anniversary meeting on November 30 as follows Royal Medals to Sir Richard Glazebrook, for his distinguished work in experimental physics, and to Professor W H Lang, for his work on the anatomy and morphology of the fern-like fossils of the Old Red Sandstone, the Copley Medal to Sir Arthur Schuster, for his distinguished researches in optics and terrestrial magnetism, the Davy Medal to Professor A Lapworth, for his researches in organic chemistry, particularly those in connection with tautomerism and the mechanism of organic reactions, the Sylvester Medal to Professor E T. Whittaker, for his original contributions to both pure and applied mathematics, and the Hughes Medal to Professor W L. Bragg, for his pioneer work on the elucidation of crystal structure by x-ray analysis.

OFFICERS of the Royal Society have been elected as follows: Sir Frederick Hopkins, *president;* Sir Henry Lyons, *treasurer,* Dr H. H Dale and Sir Frank Smith, *secretaries,* Lord Rayleigh, *foreign secretary, other members of council*—Dr. J A Arkwright, Professor G Barger, Professor W L Bragg, Professor E P Cathcart, Mr A C. G Egerton, Mr. R H. Fowler, Professor E S Goodrich, Professor G H. Hardy, Professor W N Haworth, Professor C E Inglis, Professor O T Jones, Sir Thomas Lewis, Dr N V Sidgwick, Professor A G Tansley, Professor G I Taylor and Professor D'A W Thompson

PROFESSOR K FUJII, of Tokyo, Professor Victor Grégoire, of Louvain, and Professor O Rosenberg, of Stockholm, have been elected honorary fellows of the Royal Microscopical Society

THE Royal Society of Sciences in the Dutch Indies has elected as foreign corresponding members the following Dr A Ernst, Zurich, Dr A Lacroix, Paris, Dr T Wayland Vaughan, La Jolla, Calif, Dr J Boden Kloss, Singapore, Professor G Elliot Smith, London, Mr J B Scrivenor, Natu Gajah, F M S, H Tanakadate, Sendai, Japan, M F Blondel, Hanoi, Indo-China, and Dr J Wanner, Bonn The total number of corresponding members permissible in the society is thirty The number was brought up to nineteen at the election in December, 1930

PROFESSOR HUBERT GREGORY SCHENCK, of the department of geology of Stanford University, has been elected to membership in the Geological Society of France

THE annual Chilean Nitrate of Soda Nitrogen Research Award was made at the annual meeting of the American Society of Agronomy in Chicago to Dr W H Pierre, of the University of West Virginia, and Dr Hans Jenny, of the University of Missouri

DR. WILLIAM PENN BROOKS, Amherst, Massachusetts, professor of agriculture emeritus and formerly director of the Massachusetts Agricultural Experiment Station, celebrated his eighty-first birthday on November 19

PROFESSOR ALBERT EINSTEIN has been appointed the Rouse Ball Lecturer at the University of Cambridge for the year 1931–1932 by the faculty board of mathematics.

DR. HARRY H PLASKETT, professor of astrophysics at Harvard University, has been appointed Savilian professor of astronomy at the University of Oxford and director of the observatory to succeed the late Professor H. H Turner The appointment dates from January 1. Professor Plaskett will not, however, assume the professorship until June as he is completing arrangements for a new sixty-inch telescope in South Africa and supervising the construction of a spectrograph in Cambridge.

Associate Professor Otto Struve, of the University of Chicago, has been appointed assistant director of the Yerkes Observatory Professor Frost has been making a satisfactory recovery from recent illness at the Billings Hospital, and expects to resume his duties as director within a short time

F. W Hodge will terminate his service with the Museum of the American Indian, New York City, at the close of the present year to assume the directorship of the Southwest Museum at Los Angeles, California.

As visiting professors at the Johns Hopkins University for one year there have been appointed Dr. Georg Tischler, professor of botany at Kiel, Dr William J Cooper, U. S Commissioner of Education, and Professor Edward L Thorndike, of Teachers College, Columbia University

Dr. Frederic M Hanes will be acting professor of medicine and head of the medical service in Duke Hospital while Dr Harold L Amoss is this year visiting professor of medicine in the Peiping Union Medical School in China.

M. F Miller, assistant dean of the College of Agriculture and chairman of the department of soils of the University of Missouri, has been designated acting dean and director during the six months' absence in Europe of Dr F B Mumford for a study, mainly in England, France and Germany, of world conditions affecting American agriculture

Dr. Samuel Van Valkenberg, of Detroit City College, has been appointed associate professor of climatology and regional geography at Clark University, succeeding Dr Charles F Brooks, who assumes the directorship of the Blue Hill Observatory in February Dr Van Valkenberg was a member of the faculty of Clark University from 1927 to 1929 Dr Wallace B. Atwood, son of President Wallace W Atwood, has been appointed assistant professor of physiography and regional geography

John Wagner, Jr, civil engineer, industrial agent of the Reading Company, has been elected president of the Wagner Free Institute of Science, Philadelphia, succeeding his father, Mr Samuel T Wagner, who died on August 7

H C Diehl, senior physiologist, U S Department of Agriculture, has been placed in charge of the frozen pack investigations of the department, with headquarters at Seattle, Washington, where the Bureau of Plant Industry has established a laboratory designed for research in the freezing preservation of fruits and vegetables Mr. Diehl was formerly in charge of the maturity handling and storage investigations of the department with headquarters at Wenatchee, Washington.

The following appointments have been announced at Tulane University: Dr Francis H Wilson, formerly associate professor of botany, University of Richmond, assistant professor of zoology, Dr. Dorothy W Seago, formerly associate professor of psychology at North Carolina College for Women, assistant professor of psychology at Newcomb College, Dr Bruce P Webster, formerly instructor in medicine at the College of Physicians and Surgeons, Columbia University, assistant professor of medicine, Dr William H Perkins, instructor in medicine, has been promoted to a professorship of preventive medicine and head of the department in the School of Medicine

At the annual meeting of the American Society of Agronomy held in Chicago on November 19 and 20 the following officers were elected for the coming year *President,* Dr P E Brown, Iowa State College, Ames, *First Vice-president,* Dr S A Waksman, Agricultural Experiment Station, New Brunswick, N. J , *Second Vice-president,* Professor George Stewart, U S Forest Service, Ogden, Utah, *Third Vice-president,* R I. Throckmorton, Kansas State Agricultural College, Manhattan, Kansas, *Fourth Vice-president,* Dr M A. McCall, Bureau of Plant Industry, Washington, D. C , *Secretary-Treasurer,* Dr. F. B. Smith, Iowa State College, *Editor,* Professor J. D. Luckett, Agricultural Experiment Station, Geneva, New York

At the meeting held on November 12 the Washington Section of the American Chemical Society elected the following officers: *President,* E. Wichers; *Secretary,* J H. Hibben, *Treasurer,* O. E. May; *Councilors,* S F Acree, B H Carroll, R. E. Gibson, H. T. Herrick, P. E Howe, *Executive Committee,* M. S. Anderson, J H. Bruun, J. F. Couch, R. Gilchrist, R. M. Hann and A R Merz.

Nature reports that at the annual statutory meeting of the Royal Society of Edinburgh held on October 26 the following council was elected: *President,* Sir E. A Sharpey-Schafer; *Vice-presidents,* Professor F. G Baily, Professor T. J. Jehu, Professor J. H. Ashworth, Dr A Logan Turner, Dr. J. B. Clark, Professor James Ritchie; *General Secretary,* Professor R A Sampson; *Secretaries to Ordinary Meetings,* Professor C G. Darwin and Professor F. A. E. Crew; *Treasurer,* Dr James Watt; *Curator of Library and Museum,* Professor D'Arcy W. Thompson; *Councillors,* Professor James Drever, Mr. A. H. R. Goldie, Dr R A. Houston, the Hon. Lord Sands, Dr Murray Macgregor, Dr A. Crichton Mitchell, Professor P. T. Herring, Sir Thomas H. Holland, Professor James Kendall, Professor T M. MacRobert, Professor Godfrey H. Thomson, Dr Malcolm Wilson

THE Committee on Scientific Research of the American Medical Association has extended to Dr Timothy Leary, of Boston, a grant-in-aid for a study of the influence of alcohol and of insulin upon the deposition of cholesterol in the animal body

A GRANT of $600 has been made to Dr Reginald D Manwell, of the department of zoology in the College of Liberal Arts in Syracuse University, by the National Research Council for the continuation of studies on the chemotherapy of avian malaria This is the second grant made by the council to Dr Manwell for this purpose

PROFESSOR DOUGLAS JOHNSON, of Columbia University, devoted part of the past summer to a reconnaissance study of coastal terraces along the Atlantic and Gulf Shores, under the joint auspices of the American Geographical Society, the Carnegie Institution and Columbia University In September he attended the International Geographical Congress in Paris as president of the Section of Physical Geography.

VILHJALMUR STEFANSSON, associate in anthropology at Harvard University, will give at Wellesley College in the near future a series of lectures on his archeological expeditions to Iceland, Eskimo life in the Mackenzie Delta, and other topics dealing with his explorations.

DR HARRY N. HOLMES, professor of chemistry and head of the department of chemistry, Oberlin College, on November 14 delivered an address before the Royal Canadian Institute entitled "The Applications of Colloid Chemistry."

DR. WILLEM DE SITTER, of the Leiden Observatory, Holland, lectured at the Perkins Observatory, Delaware, Ohio, on November 23, on "The Size of the Universe." The lecture was the second of the series held on the affiliated program between the observatory and the Graduate School of Ohio State University.

THE Third International Congress for Light will be held in Copenhagen from August 15 to 18, 1932 The president is Professor Axel Reyn, of Copenhagen The chairman of the American Committee is Dr Alfred F. Hess, of New York. The main subjects for discussion will be· (a) "The Rôle of Pigment in Light Biology"; (b) "The Systemic Action of Light in Tuberculosis"; (c) "Heliotherapeutic and Climatologic Research in Relation to Public Health."

THE annual meeting of the National Council of Geography Teachers will be held at State Normal College, Ypsilanti, Michigan, on Monday and Tuesday, December 28 and 29

THE fourth national organic chemistry symposium of the American Chemical Society will be held in the Sterling Chemistry Laboratory of Yale University from December 28 to 30 Sixteen papers will be presented by the following Professor Roger Adams, University of Illinois, Professor H B Adkins, University of Wisconsin, Professor M T Bogert, Columbia University, Professor H T Clarke, Columbia University, Dr. W H Carothers, research chemist, du Pont Company, Wilmington, Del , Professor J B. Conant, Harvard University, Professor L. F Fieser, Harvard University, Professor R C Fuson, University of Illinois, Professor H Gilman, Iowa State College, Professor C S Hudson, National Institute of Health, Washington, D C , Professor J R Johnson, Cornell University, Professor T B Johnson, Yale University, Dr P A Levene, Rockefeller Institute, New York City, Professor C S Marvel, University of Illinois, Thomas Midgley, Jr, Worthington, Ohio, and Dean F C Whitmore, Pennsylvania State College Dr Levene will address an evening session Another evening meeting will be in charge of Professor Fieser

THE U S Civil Service Commission announces open competitive examinations for the position of associate physicist (sound, or any other specialized branch of physics) and assistant physicist (any specialized branch of physics) Applications for the positions must be on file with the U S Civil Service Commission at Washington, D C., not later than February 2. The examination is to fill vacancies in various services. The entrance salary for associate physicist is $3,200 a year and for assistant physicist is $2,600 a year Competitors will not be required to report for examination at any place, but will be rated on their education and experience, and on a thesis, reports or published writings

MRS. FLORA FULLERTON MAXWELL, who was killed recently in an automobile accident, left half of her estate, estimated at $250,000, to Yale University The gift will be known as the Flora Fullerton Maxwell Fund and the income will be paid annually to worthy young men studying in Yale College.

A DECREE has been passed on the motion of the warden of Wadham College, University of Oxford, to record the grateful thanks of the university to Professor J Mark Baldwin for a gift of £1,000 for the capital endowment of the Edward Bagnall Poulton Fund, which was established by Professor Baldwin in

1920 in honor of his friend, the present Hope professor, with the purpose of promoting the study of evolution

THE League of Nations has accepted the proposal of the Brazilian Government to erect, at Rio de Janeiro, an international institution for the investigation of leprosy

THE buildings of the Medical Faculty at Seville have been almost entirely destroyed by fire entailing a loss of about two million pesetas

DISCUSSION

GARDINER ON CORAL REEFS

AFTER "thirty-five years of interest in the problems of coral reef formation," including "five years' work on the actual reefs," the author of the great monograph on the Maldive and Laccadive archipelagoes has at last given the hoped-for summary of his views concerning reefs, structures which are important not only in themselves but even more for their relation to the physical properties and history of the earth as a whole[1] While making the essentials of the subject clear to any educated reader, this admirable volume is full of meat for professional biologists and geologists Most of its pages are devoted to giving a remarkably complete picture of the marine and dry-land biology The present note does not attempt an abstract of the wealth of observations made by the distinguished professor at Cambridge on reef organisms, but is limited to an outline of his conclusions specially significant to geologists

(1) While Professor Gardiner agrees that nullipores are essential to reef-strength, he points out that the dominant builders below the depth of four to six fathoms are corals, and therefore considers the old name, coral reef, quite justified, especially for the Indo-Pacific region

(2) The islets of atoll and barrier reefs are chiefly composed of organic material deposited below sea-level and became dry land through a relatively recent, general, negative shift of sea-level This was not greater than about 20 feet, but probably varied somewhat from region to region in the tropical belt

(3) True reefs are geologically young "There is no proof of any atoll or barrier reef having originated previous to the Pleistocene" (p 151) or "late tertiary" (p 115) The indigenous fauna and flora of atoll islets "give no support to the idea that they were ever increased from those of larger lands, which have disappeared Indeed, there is not a single constituent of the fauna and flora of atoll islets that gives evidence for their existence for more than a few hundred years" (p 44) Like Mayor, Professor Gardiner is convinced that reefs grow rapidly enough to permit belief in the late-Glacial or post-Glacial origin of those now visible (p 66)

(4) Atoll reefs rest on plateaus that had been prepared at depths of fifty fathoms, or somewhat less, below sea-level (pp 143–144) They "form over 90 per cent of coral structures in island groups of the Indo-Pacific" (p 16)[2]

(5) Some lagoons show moderate enlargement by solution of their calcareous walls

(6) Those basins are not being filled at an important rate by detritus washed over the encircling reefs "There is no such general filling in of lagoons by coral growth and by sediment as suggested" by the Darwin-Dana theory of subsidence—a fact that "kills" the theory (p 146) Nor, in the reviewer's opinion, does it favor Molengraaff's explanation of atolls by the independent, isostatic sinking of volcanic cones

(7) The fronds of the shallow-water *Halimeda*, dredged from depths of hundreds of fathoms, had been dragged thither by wave, current and gravity, and do not indicate subsidence of adjacent reef structures This statement should give pause to those who believe that the discovery of shallow-water foraminifera in the deeper part of the bore-hole inside the Great Barrier Reef of Australia proves subsidence for the Australian shelf.

(8) After much study of the core of the famous Funafuti boring, Professor Gardiner concludes that it penetrated talus, not a sunken reef of corals in place, and hence does not prove subsidence

(9) Though the origin "of the isolated mountains and of the mountain ranges of the Indo-Pacific is still left beyond the limits of our knowledge" (p 159), he adopts the prevailing theory that the "atoll-crowned mountains of the Pacific" are volcanoes (p 162).

(10) The Glacial-control theory "accounts for the underlying Indo-Pacific reef-platforms even to details"

(11) But, he adds, "If we regard the question of

---

[1] "Coral Reefs and Atolls," being a course of lectures delivered at the Lowell Institute at Boston, February, 1930, by J Stanley Gardiner (*xiii* + 157 pages of text, 15 plates, 38 text figures). Price in the United States (The Macmillan Company), $4.25, too high for ready sale!

[2] Professor Gardiner does not mention the relatively recent evolution of the reef building species of corals Before this late epoch in earth-history, perhaps as far back as Archean time, volcanic cones and other lands, emerged, one after another, in the tropical belt of the ocean and suffered wave-planation during many millions of years. The reviewer knows of no fact that forbids one to assume such pre-Cretaceous abrasion as important in the formation of many atoll bearing, submarine plateaus, especially those of the Pacific region.

the formation of the foundations of coral reefs honestly, we are forced to admit that all our theories and considerations are mere camouflage for our lack of knowledge" (p 160)

Reginald A Daly

Harvard University

TREE TWIST

On reading the query on tree twist in Science, the idea struck me that I was particularly well situated to observe this phenomenon This is due to the fact that in north China (1) burial grounds are planted with trees symmetrically arranged, resembling an orchard, (2) these burial grounds stand out in the plain as islands at sea with no shelter for rods to miles about them (3) that most of them are planted with one species of tree the oriental white cedar or Arbor Vitae (*Thuya orientalis*) The advantages thus secured are that of isolation, so that only meteorological and edaphic forces would affect the trees. There is no slope, the substratum being an alkaline plain The trees are equally spaced so that if the wind is a factor in causing twist, the corner trees should be most twisted and the central ones least, while the others would be progressively less twisted The soil in these small plots (the largest observed was about 20 by 37 yards) would be the same, being loess with a depth of ten to twenty or more feet. In places this loess is interrupted by beds of conglomerate which would then affect the entire ground as a unit The species of tree is so "thin skinned" and the bark so striped as to make twist in the wood, and in the "insertion" of the branches, easily observable The climate is semiarid with heavy summer rainfall and very little rain the rest of the year Throughout the spring there are high winds blowing from the south and southwest for one to three days' duration These winds are so strong and dry and hot as to cause all trees of the region to develop to the northward The Arbor Vitaes thus have the boles bent often very strongly to the north This bending is most accentuated in the taller trees and at their tops

Unfortunately such a plantation does not usually develop uniformly. The trees which die out are later replaced. Moreover at times of financial stress, a tree here and there will be taken down and some time after replaced by young trees However, these factors can be taken into consideration and due allowance made, or observations in such groves can be checked by observations in groves that have had no such interference.

The present notes are based on charts plotted for four such burial grounds lying three quarters of a mile south of the Shantung Christian University campus (Tsinan, Sung.) near the village of Djang Djia, as well as on several isolated trees and a double row of fourteen trees

The twist in *Thuya orientalis* of this region is to the left In *T occidentalis* reported in Science for May 22 it is to the right Of 438 trees observed. 272 had the boles twisted to the left, 157 were not twisted, six had only the lowest two feet twisted, one was twisted in different directions every three or four feet and two were twisted to the right. There was no correlation whatever with exposure Similarly there was no correlation with the lean or inclination of the tree Some had a slight twist at the lowest two feet but were straight the rest of the way Large old trees were usually free from twist! Is twist then a hang-over of seedling development, which carries over more strongly in some individuals than in others? Certainly it is not related to wind or other obvious environmental factors

In one of the groves the two south rows and two north rows consisted of *Juniperus chinensis* Of the 38 trees standing, 20 had the boles twisted to the left, 16 were straight and two were twisted to the right There was correlation with neither exposure nor sex

The charts of these groves are to be deposited with Professor Nichols at the Osborn Botanical Laboratories of Yale University

Arthur Paul Jacot

Town of Monroe, Conn

MARINE TERTIARY IN ARIZONA[1]

In April, 1931, while studying the geology and mineral deposits of southern Yuma County, Arizona, the writer found a fossiliferous Tertiary formation that hitherto had not been recognized This formation outcrops from beneath later silts, sands and gravels, as several areas in the broad, terraced, dissected plains that border the Colorado River north of latitude 33° 10′. It consists of well-stratified, weakly consolidated conglomerates, sandstones and marls, alternating with chalky and dense limestones to make up a total maximum apparent thickness of approximately 1,000 feet Fossils from its calcareous members were submitted, through Dr John C Merriam, of the Carnegie Institution of Washington, to Dr W P Woodring, of the U S Geological Survey. Dr Woodring[2] identified the following forms: Cerithid, *Pisidium* (?), *Corbicula* (?), barnacle, ostracode, calcareous algae, and *Chara* (?) encrusted with algae (?) These forms, he states,[2] show that brackish waters once reached the region, but do not determine the age He further states [2] "Perhaps this marine invasion is the same as the one recorded in the southwestern part of the Colorado Desert, (California) which I regard as Miocene, but which most

---

[1] Published with permission of the director of the Arizona Bureau of Mines, University of Arizona.

[2] Written communication.

California geologists consider Pliocene (See Carnegie Inst Washington Pub 418, pp 1–25 1931)"

Heretofore, no Tertiary of definitely marine origin has been known to occur in Arizona, and none nearer than the Salton Sea-Carrizo Creek region, some sixty miles west of the Colorado River John Brown,[3] C P Ross,[4] and others have suggested the possibility that, in late Tertiary time, the Gulf of California may have extended far up the drainage of the Colorado River East of Parker, R C Blanchard[5] collected *Bittium* and a probable young *Corbicula* In the same area, C P Ross[6] found what appeared to be a minute *Corbicula* West of the Colorado River, opposite Cibola, Brown[6] gathered the same material as Ross Although *Bittium* and *Corbicula* are prone to inhabit brackish waters, Ross[7] did not regard the presence of the one *Bittium* and the probable *Corbicula* as conclusive evidence of the character of the waters in which these beds were deposited The barnacles found by the writer, however, are unquestionably marine

Very little faulting, no folding, and only minor tilting are apparent in this formation Near Parker, it overlies an extensive, tilted series of red beds and underlies basalt East and southeast of Cibola, it abuts against and overlies unconformably the roughly eroded slopes of granite, schist, and lavas of present-day mountains Because of such barriers, its eastward extension in Arizona may not have been great, and no traces of it were found along the river south of, approximately, latitude 33° 10′, where its limiting mountains converge to the river's channel West of the Cibola region, however, no continuous mountain barriers are apparent for a great distance John Brown's map[8] of the Salton Sea region shows many wide passes between the mountain ranges of that part of the region between the Salton Sea and Colorado River Consequently, this sea-way probably had its outlet westward towards the present Salton-Carrizo region, and thence southeastward to the Gulf of California, rather than directly along the present Colorado River channel

The writer plans to carry out further study of this formation, in as much as it offers to shed much needed light upon the Tertiary history of western Arizona.

ELDRED D WILSON

ARIZONA BUREAU OF MINES,
UNIVERSITY OF ARIZONA

---

[3] U. S. Geol Survey Water-Supply Paper 497, p 46, 1923

[4] U. S Geol Survey Prof Paper 129, pp 195–196, 1922

[5] Columbia Univ Contr Geol. Dept., vol 26, No 1, p 39, 1918

[6] See U S Geol Survey Prof. Paper 120, pp 189–190, 1922

[7] U S Geol. Survey Prof. Paper 129, p. 195, 1922.

[8] U. S. Geol. Survey Water-Supply Paper 497, Pl. 12, 1923.

THE SO-CALLED AUTOXIDATION OF CYSTEINE

IN a recent paper Gerwe[1] presents figures to show that the oxidation of neutralized cysteine hydrochloride is much too rapid to be accounted for by the extremely minute amounts of iron which may be present in a pure preparation, and concludes, therefore, that pure cysteine is autoxidizable It is very surprising that he should make this conclusion without considering the possible effect of copper in the oxidation of cysteine Gerwe[2] states in a previous paper concerning the preparation of iron-free cysteine hydrochloride by crystallization from HCl that small traces of copper which may have been present in the crude preparation were completely removed long before the iron in the early crystallizations He gives no data to substantiate this statement

I wish to call attention to several facts in a paper[3] which I published about a year ago on the catalytic action of copper in the oxidation of cysteine which bear on this question The method which I used for the preparation of cysteine at that time is very similar to the one which Gerwe describes in his recent paper The oxygen consumption of my sample was 1 2 cmm per hour for 8 mg cysteine hydrochloride, while Gerwe reports his to consume 2 2 cmm per hour for 10 mg cysteine My sample was, therefore, equally as pure as his preparation When pyrophosphate, which increases the activity of copper, was added to my sample of cysteine, there was a considerable increase in the oxygen uptake. This shows that the impurity which caused the residual oxidation was undoubtedly copper. If the metal had been iron, the oxidation would have been retarded rather than increased.

Gerwe found the oxygen consumption of 10 mg of cysteine to increase 5 22 cmm per 0 0001 mg Fe I found the oxygen uptake for 8 mg of cysteine to increase 86 0 cmm for every 0.0001 mg Cu Therefore copper is at least 16 times as active as iron. Gerwe concludes that the amount of iron necessary to account for the oxidation of his pure cysteine would be 44 times as much as could possibly be present. Since copper is so much more active than iron, the presence of this element in slightly larger amount than that calculated for iron would explain the observed oxidation of the cysteine.

A catalyst does not initiate a chemical reaction but merely alters the speed of the reaction. Naturally then even absolutely pure cysteine must undergo some oxidation or else the rate of oxidation could not be increased by the addition of catalysts. An oxygen uptake of about 2 cmm of O_2 per hour for 10 mg of cysteine is a very slow rate of oxidation (the 10 mg of cysteine would be completely oxidized only after a period of about 7 days) but if the cysteine were completely metal-free the oxygen consumption would undoubtedly be still less. The oxidation which has been observed by Gerwe can not be called autoxidation until the presence of other metals such as copper and manganese has been studied.

---

[1] E G. Gerwe, J Biol. Chem., 92: 399, 1931.

[2] E. G. Gerwe, J Biol. Chem., 91: 57, 1931.

[3] C. A. Elvehjem, Biochem. J., 24: 415, 1930.

C A Elvehjem

Department of Agricultural Chemistry,
University of Wisconsin

SPECIAL ARTICLES

A NEW MUTATION IN THE HOUSE MOUSE (MUS MUSCULUS)

In the fall of 1926 a female mouse of unusual color, caught in the country several miles from the nearest town, was brought to our laboratory The eyes were pink, indistinguishable from the eyes of the common pink-eyed varieties but the coat color, though plainly agouti, was lighter than that of a pink-eyed black agouti

A mating of this animal with a pink-eyed brown non-agouti produced young phenotypically like the ordinary wild This result indicated that this new mutation was different from the common pink-eyed form Further matings of the F_1's produced dark and pink-eyed agoutis, blacks, browns and the new mutation. This new mutation which is tentatively called p_2 is not in the pink-eye (P, p), color (C, c^{ch}, c^d, c), or dilution (D, d) series

The new p_2 gene seems to dilute both the yellow and black or brown in agouti individuals So far a non-agouti in the new mutation has not been found The combination of the new pink-eye gene and extreme dilution $c^dc^dp.p_2$ produces an animal with very little color and eliminates pigment from the ears A complete report of the inheritance of this new character together with linkage studies will be published later.

Elmer Roberts

College of Agriculture,
Urbana, Illinois

"AT THE TOP IS MAGIC"

It is sometimes difficult to understand how certain books can get published, especially by reputable publishers Many readers of Science will doubtless raise that question if they dip into "The Adventure of Mankind," translated by Robert Bek-Gran from the original German of Eugen Georg[1] The "blurb" on the jacket states that "to read it thoughtfully and to weigh its challenges should become the pleasure as well as the duty of all enlightened Americans"

Thumbing its pages as a botanist, though possibly not as an enlightened American, and more in pursuit of the promised pleasure than from a sense of duty, we read as follows:

> The poplar tree fell ill throughout all of Middle Germany. None of the trees were raised from seed, but were slips from a single mother tree, that is, they were a single individual distributed along a thousand highways Suddenly these shoots perished, because the life energy of the mother plant (in the park of Worlitz) became exhausted Similarly the La France rose has languished, the blood beeches have become decrepit, Malvasier grapes and Borsdorfer apples have turned sterile, and certain varieties of potato have disappeared, whenever they have been raised from shoots rather than, as formerly, from seeds of their kind All these descendants, these grandchildren, these daughter cultures are but segments of a super individual unity When the root dies, they die (p 234)

In other words if Ephraim Bull's original Concord grape-vine, at Concord, Massachusetts, should suffer from mildew all the other Concord grape-vines in the country, being descended from the Concord vine by cuttings, would also suffer from mildew, if the Concord grape should die that would be the end of all the Concord grapes in the world! This, we are told, is owing to the fact that there is a "rhythm of all living substances," "a magic bond which thus disregards space and time to unite the parent of a race, a family, a species with his heirs Sometimes the links are so strong that the offspring perishes with the parent, the branch with the root, the daughter with the mother—be it plant, nation or civilization." A terrible thought for daughters!

What a pity that the French physiologist, Leo Errera, whose researches illuminated the subject of "physiological action at a distance," was not possessed of these data!

On page 246 we learn that, "The influence of the moon reaches the elemental depths of our animal and plant world," so that "The sap of trees rises and falls with the phases of the moon. If the walla tree of East Africa is felled at the time of the new moon, it produces splendid building material. Cut down at the full, it has no durability at all. Plants sown under the waxing moon are strongly rooted, but those set under its wane turn mostly to leaf, hence the first phases of the moon insure the best harvest"

This passage should insure a good sale of the book in Vermont, so that those engaged in the maple sugar industry will not fall into the error of tapping their trees at the wrong phase of the moon.

In the discussion of sunspots (p. 247) we note that "The season of leafage or blossoming depends on them" This shatters the principle of photoperiodism, and incidentally ruins the reputation of the U S Bureau of Plant Industry for publishing reliable work

---

[1] Putnam's, September 28, 1931.

The statements that "Matter is apparently formed by a kind of negative atmospheric pressure," and that "An atom of matter is nothing but a kind of emptiness in space" (p 282) set us to wondering whether ideas are sometimes emptiness, formed by a negative process, but this reverie was interrupted as our eyes caught the following on page 293. "Yes, there is a scale of scientific knowledge And at its bottom we find the so-called 'exact' sciences Further up are the occult sciences—paraphysics and parapsychology At the top is magic!"

C STUART GAGER

BROOKLYN BOTANIC GARDEN

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MAYAN SYMPOSIA AND EXHIBITS AT NEW ORLEANS

THREE sections of the American Association are planning symposia dealing with various phases of the civilization indicated by the Mayan ruins On Tuesday afternoon Sections H, K and L will join for symposia on "Commerce, Trade and Monetary Units of the Mayas" and "Social and Economic Institutions of the Mayas" This program is in charge of Dr Joseph Mayer, secretary of Section L of the association Dr Mayer is working in cooperation with Professor Frans Blom, director of the School of Middle American Research at Tulane, and with the officers of Section H

At a dinner meeting on Tuesday evening the retiring vice-president of Section H, Dr Carl E Guthe, will deliver his address on the subject, "The Maya Lunar Count"

The opportunity which these meetings will afford for becoming familiar at first hand with the important work being done by the Department of Middle American Research of Tulane University is in itself a special attraction of the New Orleans meeting In this connection the following information, supplied by Director Frans Blom, is particularly interesting

In the latter part of 1924 a citizen of New Orleans created the Department of Middle American Research, with an endowment of $300,000 and the purchase of the William E Gates Library, containing about 3,500 books, pamphlets and autographs pertaining to the ancient and modern history of Mexico Mr Gates was appointed the first director of the new department and functioned as such until the first month of 1926

The aim of the department is to conduct research in Middle America (*i e*, Mexico), the Central American Republics and the West Indies, covering the ancient, the colonial and the modern history of these countries, their geography, botany, ethnology, etc, and to form a library which it is hoped will eventually be one of the most complete and comprehensive on this subject in the United States

In 1925 the First Tulane University Expedition departed from Vera Cruz, Mexico, and during six months conducted investigations, chiefly of an archeological and ethnological nature, in the southern states of Mexico and part of Guatemala The results of this expedition were published in a two volume report entitled "Tribes and Temples." During the same year an agronomical investigation was made in the State of Tabasco, Mexico, and the part of this survey which related to the possibilities of growing rubber was published in the U S Government report entitled "Possibilities for Para Rubber Production in Northern Tropical America," U S Department of Commerce, 1926

The library was augmented with the purchase of the George H Pepper library

After Mr William E Gates' departure, Mr Frans Blom was appointed acting director, with Mr Oliver La Farge II as his assistant Later, Professor Hermann Beyer joined the permanent staff Professor Rudolph Schuller conducted some temporary work, and from him a fine collection of pamphlets was purchased

In 1927 the Third Tulane University Expedition, headed by Mr La Farge, and with Mr Douglas Byers as assistant, spent several months in the highlands of Guatemala, investigating the Indian population of the town of Jacaltenango

During the same year the Sedly Mackie Library was purchased, and through this purchase the department's library with one stroke attained an important position The Gates Library contained some fine manuscripts and linguistic material, the Pepper Library added much valuable pamphlet material, specially of a more general nature, and the Schuller collection, made in distant parts of Central America, contributed many rare imprints Finally the Mackie library presented a most astoundingly complete gathering of the classics of Middle American Research, with an abundance of rare items.

It was evident that the limited funds of the department would not permit the purchase of museum specimens, the financing of expeditions and the upkeep of a library at the same time, and as it is just as evident that the library is the foundation for sound research, all stress was thrown on the formation of a first rate collection of books. Funds for expeditions were raised outside of the regular income. It soon was noted that New Orleans, as the gateway to Middle America, contained several private collections of archeological and ethnological objects, most of them comparatively small, but which, when brought together, would form an excellent nucleus for a Middle American museum. Fortunately, the greater part of the local collectors were well disposed toward the department, and thanks to their cooperation there has been gathered a small but quite select exhibit of objects from the field in which the department specializes.

Since it has become known that the department is interested in purchasing books and manuscripts relating to Middle American subjects, many rare items have been brought to New Orleans for sale. As a result it can now be stated that the library of the department contains one of the most complete collections of books and documents relating to the Maya, their country and history, among which are such rarities as the original of the famous documents of Mani in Yucatan, written in the Maya language, but in Latin characters (the oldest document of its type known, dated 1557), as well as several other sixteenth century documents in the Maya language. The collection of Nahuatl linguistics is remarkably complete. From the Gates library came such rare things as the original manuscript to Gilberti's vocabulary of the language of Michoacan, Mexico, and an original Father Olmos MS. The Mackie library held such a rare and charming item as the original edition of Vargas Machucas Milicia, Indiana, printed in 1599, and with a full manuscript page in the hand of Robert Southey, poet laureate, author of "Maddox," who bought the book in Milan on the 16th of June, 1817.

During the New Orleans meeting of the American Association the collections and library of the Department of Middle American Research will be open, and a special exhibition will be made of the rare manuscripts, books, pamphlets and bindings, all intimately connected with truly American history and development.

In addition to this exhibit of the library of the Department of Middle American Research, the director plans an exhibit in connection with the association's scientific exhibition at the Municipal Auditorium.

The Carnegie Institution of Washington, which has been very active in research work in Middle America, plans to use about 1,000 square feet in the scientific exhibit hall for an exhibition of some of its Mayan work.

Facilities for excursions to Mexico City and Yucatan will be available. The United Fruit Company's ss *Olancho* will leave New Orleans on January 2 in the afternoon. The round-trip with visits to Mexico City, the Pyramids of Teotihuacan, Puebla and Cuernavaca included will cost $165.00. Delegates will be returned to New Orleans on January 12. A boat for a ten-day round trip to Yucatan will leave shortly after the convention. The Yucatan trip with visits to various ruins, including Chichén Itzá will cost $150.00.

THE NATIONAL ACADEMY OF SCIENCES

At the autumn meeting of the National Academy of Sciences, held in New Haven, Connecticut, on November 16, 17 and 18, the following papers were presented.

New concept of evolution based upon researches on the Titanotheres and the Proboscideans. Henry F. Osborn. (Printed in Science this week.)

The geological significance of the relief of western Central Asia. Helmut de Terra (introduced by A. Knopf).

Coral reefs and sand reefs. W. M. Davis. Agassiz reported in 1898 that the southern or polar end of the Great Barrier Reef of Australia is determined by the equatorward drift of sands on a long sand reef, just as the northern or polar end of the much smaller coral reef of Florida is determined by the equatorward drift of sands on another long sand reef. Hedley, of Sydney, described in 1911 a remarkable increase of sea bottom depth near the end of the Australian reef, as shown by comparing Admiralty surveys of 1869 and 1904, but he did not connect the increase of depth with wave action consequent upon the smothering of reef corals by encroaching sands. In certain areas the depth increase was reported to be from 20 to 30 to 200 or 300 fathoms. Such an increase seems incredible, but on inquiring of the Admiralty Office in London I was informed that both the earlier and later surveys were regarded as authentic. And in reply to a recent inquiry a tracing has been generously sent me showing the position of the 100-fathom line off the coral reef end in 1869, 1898, 1904 and 1911, and 1928. The line retreated from 2 to 4 miles in the first interval and from 2 to 3 miles in the second, but it advanced 1 or 2 miles in the third or latest interval. Hence there seems to be no question whatever that rapid changes in depth have taken place in the sea floor hereabouts during the last half century, primarily involving strong increases and secondarily moderate decreases of depth. No similar increase of depth has taken place near the coral reef end along the Florida coast: charts showing detailed soundings made in 1852 and 1931, copies of which have been provided me by the superintendent of the U. S. Coast and Geodetic Survey, indicate only moderate increases of depth, probably because the Florida coral reef does not stand so far off shore as the Australian reef; so that when the Florida corals were smothered by sand drift no great change of sea-floor depth was called for. The encroachment of the Australian sand reef appears to explain why the Great Barrier Reef fails by a hundred miles or more to reach the southern limit of reef growth in the adjoining sea. And if a significant encroachment has taken place in the 35 years between surveys of 1869 and 1904, a much greater encroachment should have occurred since the present relation of land and sea were assumed some thousands of years ago. Similarly, in view of the former and much longer enduring relation of land and sea levels in an earlier epoch before an eastward down-tilt of the land margin and the sea floor introduced the present relation, it may be inferred that the equatorward encroachment of the sand reef on the coral reef of that epoch may have measured many hundred miles Various significant consequences follow from this inference, the most important of them is that the equatorward extension of the sand reef during that earlier epoch may perhaps account for the 173 feet of quartz sand found below 427 feet of coral-reef rock in a recent reef boring a long distance north of the present coral reef end The object of the present note is to call attention to this possible explanation for the occurrence of the quartz sands as an alternative to various other explanations that have been proposed

The use of rock crystal by Paleolithic man. GEORGE GRANT MACCURDY One of the first steps in the ascent of the ladder of culture was taken when man began to find artificial means of adding to the effectiveness of the powers with which nature endowed him He found by experience that a club supplemented arm strength and the sharp edge or point of a flint chip was more serviceable for cutting and puncturing than nails or teeth Before the close of the Stone Age he had experimented successfully with at least forty seven varieties of stone, but not all of these were in use by the close of the Paleolithic period His sources of supply were chiefly from the silicates, carbonates were also used to a considerable extent Of the silicates the species known as quartz was found to be especially adapted to the needs of primitive man There are two varieties of quartz—cryptocrystalline and phenocrystalline The great bulk of Stone Age implements was made of cryptocrystalline quartz in the form of flint, chert, chalcedony, hornstone, quartzite, etc By comparison, implements of phenocrystalline quartz are rare indeed This is an oxide of silicon and is known as rock crystal, it was not in use prior to the Mousterian epoch In other words, the chipping of tools from rock crystal began with Neandertal man In addition to its rarity rock crystal can not be chipped with the same ease as can flint Complete tools of rock crystal dating back to the Mousterian epoch are exceedingly rare We appreciate all the more the good fortune that has come to our American School of Prehistoric Research in the finding of seven perfect rock-crystal tools not only in one rock shelter but at one level in that rock shelter (the lower of two Mousterian levels) This shelter is known as Les Merveilles and is at Castel-Merle, near Sergeac (Dordogne). Upper Paleolithic deposits, especially Solutrean and Magdalenian, have yielded several rock crystal tools. Solutrean points of the laurel-leaf type, beautifully chipped on both faces, have been reported—one from Le Placard (Charente), one from Liveyre, near Les Eyzies (Dordogne), and one each from Badegoule, Balutie and Laugerie Haute (Dordogne). Three rock-crystal tools of Magdalenian age have been reported—one from Laugerie Basse (Dordogne) and two of indifferent workmanship from Le Perron (Haute Loire) Since three adjoining departments in south central France—Charente, Dordogne and Corrèze—have yielded practically all the Paleolithic tools of rock crystal known to date, a single center somewhere near the headwaters of the Vézère might well have been the source of rock crystal supply for the Paleolithic sites in question.

The supposed 2 meter eustatic bench of the Pacific shores DOUGLAS JOHNSON (introduced by W M DAVIS).

The new ganometric method of subdividing Plio-Pleistocene time based on the enamel foldings of the superior grinding teeth of the fossil and living elephants HENRY F OSBORN

Clear Lake, California W M DAVIS Clear Lake, about 25 miles in length and from 20 to 40 feet in depth, lies 100 miles north of the Golden Gate and is the only lake in the Coast Ranges of California It covers one of the many intermont basin plains of those mountains, and it results from a landslide of recent but unknown date which obstructed a deep gorge by which the drainage of the pre lake plain was discharged through the enclosing highlands on the northwest The lake rose until, on gaining a depth of 60 or 80 feet, it discovered in the mountains on the east another deep gorge, the head of which lies in a notch but little above the western base of those mountains There the overflowing lake waters cut a cleft in the low notch at the gorge head and thus lowered the lake some 30 feet nearly to its present level. Later changes of small measure have been introduced by blasting away a rock barrier two miles west of the cleft and by building a dam in the cleft in order to control the outflow for irrigation The prevailing level of the lake has thus been somewhat lowered No other deep gorges are found in the basin-enclosing highlands The two existing gorges, one of which formerly led out the drainage of the pre-lake plain, while the other now leads out the overflow of the post-landslide lake, appear to be of antecedent origin; but if so, the stream through the eastern gorge must have been defeated by basin-producing deformation at a well-advanced stage of basin development. Previous to that defeat, the single basin plain would appear to have had two outflowing streams of antecedent origin. This might seem impossible, if the smaller Laytonville basin plain, some 30 miles farther northwest, did not to-day possess two outflowing streams which follow deep-cut gorges and which are also apparently of antecedent origin, the divide between their heads being on the flat basin plain. Such paired basin-draining gorges can hardly be the result of erosion along fractures, for in that case they should be more numerous. They do not seem to be the work of consequent streams which flowed on the even surface of a previously deformed and completely filled basin, degrading the weak filling of the basin in a broad plain, while they cut only narrow gorges in the resistant rocks of the basin-holding mountains, for there is no evidence that the basin was ever completely filled. On the other hand, it is difficult to imagine that the paired gorges are the work of small antecedent streams, for in that case two such gorges for a single basin would ordinarily be one too many. Yet, as the case now stands, an antecedent origin for the paired gorges seems more reasonable than any other. Hence the previously prepared eastern gorge, now followed by Clear Lake outlet, should be looked upon as the most remarkable feature of that interesting and picturesque district.

Submarine valleys: **Francis P. Shepard** (introduced by W. M. Davis).

Biographical memoir of Raphael Pumpelly (read by title): **Bailey Willis**.

The incubating python: a temperature study[1]: **F. G. Benedict, E. L. Fox** and **V. Coropatchinsky**. The incubating python, rarely observed in zoological parks, has been studied at the National Zoological Park in Washington, D. C. A thermoelectric survey of the temperature of the air around the snake and of the skin temperature of the snake (on the exposed surfaces, between the folds, and between the snake's body and the eggs) showed that the snake's temperature was definitely higher than that of its environment. Since under ordinary conditions snakes have a temperature a little lower than the environmental temperature, the incubating python is living under a special body temperature regulation during the period of incubation.

The effect of exercise continued for several generations on the weights of the organs of the albino rat: **Henry H. Donaldson**. The captive albino rat of our laboratories is a mutant derived from the wild Norway rat. It differs from the parent stock in having a brain from 12 to 14 per cent. less in weight. This difference is not originally due to albinism, and therefore seems to be an effect of captivity. In captivity the rats usually have less opportunity for exercise than under wild conditions. The attempt was made, therefore, to determine whether an increase in the amount of exercise, by placing the animal in a cage with a revolving drum, would modify the weight of the brain. During the past 20 years three previous studies of this question have been made in our laboratory. They show that the weight of the brain may be thus increased from 2 to 3 per cent. The weight changes in other organs were also determined. All these experiments, however, were for one generation only. It was decided, therefore, to carry the same experiments through several successive generations, and thus determine whether there was any cumulative effect on the weight of the several organs. For this purpose two families were used—and each was carried through seven generations. All the rats lived their entire life in the revolving drum cage in which the exercise was taken voluntarily. One series of these was examined at 56 days of age—and the other at 220 days. The resulting changes in the fresh weights of 15 organs, including the brain, are here presented. The amount of difference in weight is represented by the percentage deviation of the tests from that of the controls, and it is seen in the 220 day series (chart) that in five organs of each sex (the gonads, kidneys, suprarenals, submaxillaries and heart), the changes are plus and large, while in two organs, the liver and the thyroid, they are minus—*i.e.*, these latter organs have increased in weight less than the controls. This change in weight is mainly due to alterations in the size of the formed cells, combined with a possible increase in the number of cells in some glands. The changes induced by seven generations of exercise are not greater than those following one generation—and there is, therefore, no cumulative effect, nor is there any such effect as between the last and first generations in the series of seven. When the deviations for the sexes combined in the 220 day series are compared with those shown by the 56 day series, it is seen (chart) that the smaller amount of exercise taken by the 56-day series has yielded changes in general similar to those of the 220 day series, but for the most part less marked. Exercise thus produces weight changes in a number of organs in the albino rat. In man similar changes in the heart and musculature have long been recognized, but it is not possible to carry out on man experiments of the type here described. Nevertheless, the physiological similarities between the albino rat and man warrant the inference that similar organ changes would take place in man, and thus become a factor in bringing about the beneficial effects commonly recognized as following vigorous exercise.

Experiments on early stages of rat embryos: **J. S. Nicholas** (introduced by R. G. Harrison). Previous experiments by the author have shown that rat foetuses are capable of continuing their development after certain types of experimental interference. While the technical difficulties are great, the results warrant additional investigation of the possibilities of embryonic development in mammals under experimental conditions. The results here reported are founded on two series of experiments, (1) the production of extrauterine pregnancies, and (2) the transplantation of total embryos into regions outside the abdomen. In the first series the production of extrauterine pregnancy was attempted by transplanting the embryo to various structures within the abdomen. The embryos became implanted upon mesentery, but generally were rapidly resorbed. Since the segmentation stages of development occur in the Fallopian tube, the pregnant females were operated upon on the third day after fertilization and the uterine horns severed from their upper connections with the tube, their lumina being occluded by ligation. Under these conditions the segmenting blastocysts drop into the abdominal cavity either to degenerate or to continue development. Development was secured in 2 per cent. of the cases (5 positive in 250). In order to test the capacity of the embryo to develop outside the abdominal cavity one horn of the uterus was delivered through an incision in the body wall Its proximal and distal parts were retained within the abdomen, while the uterine horn with its contained 8-day embryos was held in a pocket under the skin by suturing the body wall. Under the conditions of this experiment development proceeds normally, the fetuses are born at term and are viable Transplantation of eight- and nine day embryos in locations outside of the abdomen has been performed The femoral triangle, muscle of the body wall and other locations have been tried The most favorable site for transplantation thus far secured is the mammary gland Embryos transplanted to this region undergo disorganized tissue formation Muscle, both smooth and striated, cartilage, nervous tissue, gut and red blood cells, as well as placental cells, are differentiated and can be distinguished in sections through the graft The tissues differentiate in their foreign locations in typical form but do not complete the organization of the individual

---

[1] From the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts.

The analysis of the factors determining the growth of a population of yeast OSCAR W RICHARDS (introduced by L L Woodruff) The growth of a population of a pure strain of the yeast *S cerevisiae* Hansen derived from a single cell is measured for about 1,200 hours The rate of increase of the population is constant until the waste products (by products of fermentation) retard the increase by selectively eliminating the buds which have not had time to become resistant after they are independent of the mother cell The population then reaches an equilibrium number and the first cycle of growth ends As the sugar is rapidly used less waste products are produced and less cells are killed The oxygen consumption is greatest then and food material is liberated by the cytolysis of the killed cells This results in a more favorable medium and the population again increases until further growth is prevented by the accumulation of waste products in the medium and the utilization of the available food If additional food is added just before the end of the first cycle of growth the growth continues to the same level as would be reached later at the end of the second cycle The further addition of food does not result in additional growth After the second growth cycle the structure of the cells changes and most of them gradually become resistant, resting cells The remainder perish except for a very few hardy cells which continue to reproduce for a long time The potentially unlimited growth of the cells is restricted and determined by the chemical changes in the medium

The maturation of the egg of the sea-urchin Mespilia globulus D H TENNENT In this brief paper one section of a complete study of the history of the chromosomes during the oogenesis of the sea-urchin *Mespilia globulus* that has recently been completed by Dr Toshio Ito, of the Medical School of Keio University, Tokyo, and myself, will be presented The sac like ovaries, at this time, are packed with oocytes, some of which are still in their growth stage Sections show that the wall of the ovary consists of three layers, a thin outer layer, the coelomic epithelium, a middle layer of muscle fibers and an irregular inner layer of oocytes, the so-called germinal layer The oocytes lie in an almost structureless lacunar matrix, within which there are also a few small, apparently amoeboid cells As the oocytes increase in size some are crowded away from the wall, the number of full grown oocytes lying in the center of the ovary thus increasing gradually Two points should be emphasized There is never any stalk of attachment and there is never a definite cellular egg follicle All the cells lining the wall in which the nucleus is large or has begun to enlarge are oocytes Maturation may take place while the oocytes are still in contact with the wall or after they have been forced to the center of the ovary In only one, out of several hundred examples, have the polar bodies been given off from the surface of the egg adjacent to the wall of the ovary As a rule, therefore, the animal pole of the egg has developed in the free, rather than in the attached surface In maturing eggs lying in the lumen of the ovary there is never common orientation of the spindle with respect to a selected region Prior to the onset of the growth stage in the oocyte the chromosomes disappear after reaching a diplotene stage At the onset of the meiotic divisions they reappear as diplotene chromosomes in the nucleus of the fully grown oocyte They become arranged on a typical amphiastral first polar spindle and during early anaphase stretch out as V's and rods While the chromosomes are separating during the later anaphases and while the spindle system is moving toward the periphery of the egg, the outer aster becomes flattened, the outer end of the spindle finally becoming anastral The surface of the egg above this blunt end is pushed out as a bud, into which the anastral end of the spindle and the outer chromosomal plate moves On the equator of the spindle, in fixed and stained preparations, a belt of deeply stained granules constituting a "between body" may be seen In slightly later stages these granules may be seen in the form of a complete ring surrounding the spindle, the ring seeming to constrict around the spindle, until, when separation is completed, it lies as a large granule or disc on the surface of the egg just below the separated polar body

The chromosomes left in the egg become arranged on the second polar spindle, which is also at first amphiastral and whose outer end later becomes anastral as it moves out into the second polar body Here again the phenomenon of a "between body," in the form of a ring that seems to constrict around the spindle, is evident. The second polar spindle and the "between body" interrupt the continuity of the thin jelly layer surrounding the egg that becomes evident about this time This break in the continuity of the jelly layer explains the origin of the micropyle or funnel at the animal pole of the egg It has been possible to observe the form and number of the chromosomes in this egg during both maturation divisions. The observations made on this material have made it clear that development from primordial germ cell to oocyte does not take place in the "germinal layer," they have afforded a satisfactory description of the number and form of the maturation chromosomes, they have shown the manner of origin of the micropyle, and they have confirmed the conclusion reached by Jenkinson in 1911, to the effect that the animal pole of the sea-urchin egg is not at the attached, but at the free end of the egg

Feather structure in the Phasmidae **Stanley Ball** (introduced by L L Woodruff)

Cancer and tuberculosis, with some comments on cancer and other diseases **Edwin B Wilson** and **Helen C Maher**

Measures of certain human abilities throughout the life span **Walter R Miles** (introduced by Raymond Dodge) This investigation, conducted in the department of psychology at Stanford University, reports measurements on 335 boys and men and 528 women and girls The age range was from 6 to 95 years Effort was made to secure approximately equal numbers of people within the successive semi decades At first adults 50 years of age and older were studied Later, the younger years were added for comparison The study was conducted in two small cities by the establishment of laboratory annexes easy of access to the people who were to be examined These individuals were solicited and sent by many different lodges, clubs, churches and other organizations of these cities The clubs (not the individuals) were paid for this service in terms of the ages of those subjects supplied The measurements were psychological (not medical or physical) and occupied a period of two hours broken up into half hour sessions, with suitable rest intervals in between The ability to organize and carry out simple movements with the hands was studied There was practically no difference between males and females In general, the performance of the dominant (right) hand was about 12 per cent superior to that of the subordinate (left) hand The maximum ability appeared in the age range 16 to 29, while ages 12 to 13 and 55 to 59 were each 14 per cent slower Ages 10 to 11 and 60 to 64 gave equal scores, both 18 per cent below maximum group ability, 8 to 9, 25 per cent below, 70 to 74, 33 per cent and 85 to 89, 50 per cent decrement

Ability to respond to outside auditory signals with hand and foot were studied Simple response of this character is very slightly faster for the hand than for the foot On the average for adults 25 years old or older, the (unpracticed) time required is very close to one quarter of a second. The peak or standard ability in this function is maintained from age 18 to 55, where it averages close to one fifth of a second Adults 75 to 90 average close to one third second, but approximately 20 per cent of these older adults are as fast as the average for groups ranging from 25 to 90 years Most of the abilities studied show an increase during the early years, a fairly long crest representative of maturity, and a regular decline rather than a sharp change In the age period 75 to 85 the decrement scarcely ever exceeds one quarter to one third of the score value represented at group maximum. Decline appears to proceed regularly and slowly and the average old person can still perform as well as many of those who are in middle age, indicating that chronological age is by no means the sole factor accounting for performance ability The investigation is being continued

Experiments on the development and growth of limbs in the Amphibia **Ross G Harrison** The vertebrate limb develops as a thickening of the mesoderm of the body wall, covered by epithelium (ectoderm), which is part of the general integument of the body This thickening with its covering in the embryo is known as the limb bud In the salamander, Amblystoma, the limb bud, while not sharply bounded like a stone in a mosaic, is nevertheless fairly definitely localized in the body wall ventral to the third, fourth, fifth and part of the sixth muscle segments This system lends itself readily to a great variety of extirpation and transplantation experiments, which are the basis of the present investigation The respective rôles of the two layers, ectoderm and mesoderm, in the development of the limb have been tested by grafting each separately to other parts of the embryo, by replacing each separately by corresponding tissue from other regions, by changing the orientation of one layer by itself and by combining tissues of two different species Growth and pigmentation of grafted limbs have been studied in twenty interspecific combinations (between five species) in which the whole limb bud was transplanted For the embryo from the stage with closing neural folds to the stages with tail bud, the evidence is overwhelming that the capacity to form a limb is inherent in the mesoderm—particularly that of the region described above—and that the ectoderm is not specifically differentiated Grafting of trunk ectoderm to the limb region is followed by the normal development of the limb, while the reciprocal operations of limb ectoderm to other parts of the body never result in the development of a limb at the seat of the graft Mesoderm of the flank put in place of mesoderm of the limb bud is followed by suppression of the limb, while mesoderm of the limb region grafted to the flank or, under certain conditions, to the head develops into a well formed appendage In contrast to ectoderm from the trunk, ectoderm from any part of the head, taken from embryos after closure of the neural folds, and made to replace limb ectoderm, suppresses the development of the free appendage, while permitting the development of the shoulder girdle However, if the same ectoderm of the head, particularly of the gill region, is grafted in the same way just before closure of the neural folds the limb bud covered by it develops normally When the whole limb bud is rotated 180° about the transverse axis of the embryo its laterality is reversed and frequently it is more or less completely reduplicated If the mesoderm alone is rotated the result is essentially the same, but if the ectoderm alone is rotated normal development usually follows. However, in about 17 per cent. of the cases (9 out of 53) some tendency to reduplication is shown, which is not surprising, since the ectoderm is known to be polarised in other respects and the combination is therefore disharmonic In interspecific grafts of whole limb buds it is known that the graft grows at its specific rate, and in certain combinations with very different growth rates, limbs that are entirely out of scale with the body (either too large or too small) are produced In fact, unless the animals are given maximal feeding, the grafted limb may even exceed both the host and the donor control limbs in growth. Similar results, though with perhaps slightly less quantitative differences, are obtained when mesoderm alone is grafted, but when ectoderm alone is grafted the effect on the growth of the limb is very slight These results have not been subjected to all the requisite statistical tests In any case, whether the effect of the ectoderm on growth of the limb is significant or not, the quality of the mesoderm certainly dominates the growth rate. The form of the resulting limb is very nearly if not precisely that of the species furnishing the mesoderm This comes out strikingly both in appendages growing in their normal position and in those growing on the flank or on the head. The amount of webbing of the digits, which differs among the species used, may, however, be slightly influenced by the ectoderm Even the reduplicating limbs that often arise from grafts placed on the flank have the specific character of the species from which the mesodermal graft was taken, and in only one or two doubtful cases resembled the limbs of the host species Such limbs are therefore not produced from host tissues by induction Induced limbs have been found in a few cases after grafting the nasal placode to the flank, as found by Balinsky and others after grafting various organ rudiments or even foreign bodies In one case we obtained the remarkable paradox that one nasal pit grafted over the limb region suppressed the development of the normal limb, while the other nasal pit grafted to the flank produced by induction a limb where it would not normally have developed The pigmentation of grafted limbs in normal location is approximately that of the host species except in combinations in which albinotic individuals (axolotl) take part A grafted limb from a white embryo does not acquire pigment when placed upon a pigmented host and a graft from a pigmented embryo remains pigmented on a white host, as shown by Ruud (also by Schaxel for regenerative buds) These results are interpreted to mean that the pigmented individuals of the five species used have essentially similar pigmentary equipment, and that their coloration, even to a great extent the pattern, is determined by the internal medium of the organism Only in the case of the white individuals, which lack pigment largely though not entirely, is there inability to respond to the internal conditions.

Differentiation of reflex and voluntary responses of the lid HELEN PEAK (introduced by Raymond Dodge) The experimental facts regarding the distinction between reflex and voluntary reactions are incomplete and further investigation of the problem is needed in view of the interest in determining whether "conditioned" behavior is of reflex or voluntary origin. Lid responses dependent on instructions to wink voluntarily are of longer average latency than responses which are relatively independent of such instructions Longer latency is, therefore, a distinguishing characteristic of voluntary response within certain limits The present paper reports the investigation of certain other characteristics of these long and short latency responses, such as extent of closure, velocity and duration of closing and opening phases of the lid response Five thousand photographic records of the lid movements of six subjects, reacting under four sets of instructions to auditory stimulation, show the following results (1) The extent of closure in the long latency reaction is greater on the average than that of the reflex. (2) In the reflex response the promptness of opening the lid after closure increases with increase in the velocity of closure, *i e.*, the faster the lid closes, the more promptly it opens This suggests the operation of a mechanism akin to Sherrington's stretch reflex (3) In the voluntary response the relationship, though not consistent, tends to be in the opposite direction, *i e*, the faster the closure, the slower the opening (4) The voluntary response is distinguished by a greater delay in the opening phase of response with the following exceptions (a) When negative adaptation has caused the closing velocity of the reflex to fall below a certain minimum, the opening duration is increased and becomes greater than that of the voluntary (subjects were unable to increase the duration of opening in reflex by deliberate effort), (b) when a subject was instructed to increase the promptness of opening in his voluntary responses, he was able to do so, but *only after practice.* (5) This evidence indicates that when responses are measured in terms of any of these characteristics, "reflex" and "voluntary" are not distinct categories but only convenient terms for distinguishing modes in continuous distributions of response.

The cats of Rancho La Brea; a climax in evolution: JOHN C MERRIAM The asphalt deposits of Rancho La Brea near Los Angeles have furnished a unique collection of fossil remains from the geological period immediately preceding the present. The collection consists of unmodified skeletons representing a wide variety of animals It gives a picture of the life in this region at the time these deposits were forming So far as known it is the largest body of material representing the life of this period that has been obtained from a single locality. The collection is also unique in that it contains a larger percentage of carnivorous animals than would be found in any normally balanced fauna. The cats of Rancho La Brea include numerous individuals from both the saber-tooth and true cat groups At least six species are represented. They include two species of *Smilodon*, one lion-like cat recognized as *Felis atrox*, two pumas, both new species, and one smaller cat practically identical with *Lynx rufus* of the living California fauna. The large size and high stage of development of species in both groups mark a climax in evolution of this carnivore family. The paper presents results from an extended study involving several persons and institutions.

A preliminary report on functional psychoses. H. Beckett Lang and J. A. Paterson (introduced by W. D. Bancroft). Experiments with forty-six patients suffering from functional psychoses have shown a correlation between the type of insanity and the state of dispersion of the brain proteins. Schizophrenia is an over-dispersed type. Manic depressive and epileptic patients are in a coagulated state. Sodium amytal and sodium rhodanate are helpful for diagnostic purposes. These will not displace known and applicable methods of therapy but may supplement them.

The physiological properties of bulbocapnin. Wilder D. Bancroft. Bulbocapnin produces in cats a catalepsy which has been identified by Dr. Walter Freeman and others as corresponding to dementia praecox catatonia in man. If this were so, bulbocapnin should be a peptizing agent for proteins. Actually, it is a coagulating agent and brings a man out temporarily from the ordinary catatonic stupor. Sodium rhodanate and ephedrine counteract the action of bulbocapnin on rabbits. The bulbocapnin stupor in cats corresponds to what Dr. Lang calls benign stupor in man. This last is a coagulated state.

Induction of the ear by the medulla and its relation to experiments on the lateralis system in Amphibia.[1] L. S. Stone (introduced by R. G. Harrison). In the development of amphibians the ear and the lateral line first appear as an acustico lateralis placode in the ectoderm near the medulla of the primitive brain tube. The lateralis system soon separates from that of the ear as pre- and post auditory placodes, parts of which give rise to ganglia and parts to migratory primordia that lay down lateral line sense organs. This system when vitally stained is ideal for studies upon the phenomena of polarity and growth direction and what relation the establishment of these has to structures in its environment. For example, in the postauditory placode the anterior ganglionic pole near the ear and the opposite or posterior migrating pole are determined soon after the closure of the neural folds. This occurs before ear-forming cells can be completely isolated experimentally from it and at a period subsequent to that in which Dr. R. G. Harrison found the establishment of the polarity of the ear. In the early tail-bud stage the ear and the ganglionic pole of the lateralis placode can be excised without effect upon the migration of the opposite pole and the formation of lateral line sense organs. If, however, a polarized or non-polarized placode is grafted to a new position upon the side of the body the ganglionic pole will differentiate, but the migratory pole lies dormant and is unable to organise itself into sense organ forming tissue unless a migrating primordium of the host eventually touches it. Then the growth direction of that of the graft is dominated by the host primordium. If, furthermore, one includes a portion of the medulla along with a polarized acustico-lateralis placode and places the graft upon the side of the body the lateralis placode goes a step further in the formation of a few sense organs, but still it does not migrate in the presence of well-formed brain tissue. The presence of the latter may have some connection directly or indirectly with the degree of development of the primordium to the point of sense organ formation. It can not be said that strange ectoderm prevented the initiation of migration, for control experiments have shown otherwise. The ear on the other hand was not normal. This may indicate that the lateralis itself could not be expected to be fully developed in all respects. At the moment migration is normally initiated a disconnection from the associated ganglion and the brain by transplanting the primordium to the side of the body far from its normal environment does not interfere with its ability to proceed in migration and to lay down lateral-line sense organs in the direction toward which its pole is oriented. Its growth direction may be entirely changed, however, if in its grafted position it lies so that a similar migrating primordium of the host touches it. Its growth direction is then dominated by that of the host primordium. Its power to reach the point when the migratory ability is initiated must therefore in part depend upon a phase in development during a stage when it is closely associated with the ear and the medulla. It was found to be practically impossible to eliminate all the ear forming cells from the earliest stages in the ectoderm before the acustico lateralis was even recognizable as a placode without eliminating the lateralis also. It was desirable then to discover what influence the medulla was normally exerting upon the ectoderm lateral to it. Therefore, the medulla forming portion of the neural plate was transplanted to the side of the body and placed in such a manner that the lateral edge of the medulla touched the overlying body ectoderm. An incomplete ear with its ganglion was induced, but no lateralis placode. Since the center of the acustico lateralis placode, *viz.*, the ear, was so feebly developed out of the indifferent body ectoderm it may indicate that the graft was taken at a time in its development when its inductive power was limited only to a selective part of the system, or that the ectoderm itself resisted the full influence of the medulla. It may indicate furthermore that the medulla has induced only the dominant part of the system and that if a well-developed ear could have been formed it in turn might have been able to induce secondarily the lateralis portion. Whatever the case may be it at least emphasizes the necessity of a new conception concerning the early development of these two interrelated systems in order to understand more fully the methods by which the polarity and subsequent migration of the lateralis is accomplished.

Discovery of Upper Eocene land mammals on the Pacific Coast: Chester Stock (introduced by J. C. Merriam). In the stratigraphic column of the Coast Ranges of California the Sespe formation occupies a position between marine deposits of Eocene age and marine deposits of Lower Miocene age. North of the Simi Valley in Ventura County the Sespe is 7,470 feet in thickness, rests with disconformable contact on the Domengine horizon of the Eocene and is conformable with the overlying Vaqueros marine beds of Lower Miocene age Greenish and maroon shales and sandstones which are particularly characteristic of a conveniently recognizable middle division of the Sespe in the Simi anticline have yielded vertebrate remains Occurrences of fossil mammals range vertically in the section from approximately 1,600 feet to 3,000 feet above the contact with the Eocene The fauna includes *Paramys*, a creodont, insectivores, bunoselenodont artiodactyls, an agriochoerid, *Epitriplopus* (?), an amynodont and titanotheres Some of the more important features of the discovery of this assemblage are (1) The earliest Tertiary record of land mammals thus far known on the Pacific Coast, (2) the occurrence offers opportunity to establish on the basis of vertebrate paleontology the time relationships of the early Tertiary portion of the stratigraphic column of the Coast Ranges to the continental sequence as determined in the Rocky Mountains and western Great Plains, (3) several mammalian types in the fauna are structurally more advanced than related forms of the Upper Uinta Eocene and are evidently more primitive than forms known from the White River Oligocene, (4) added information is available concerning the geographic distribution of some early Tertiary mammals in North America

---

[1] From the Department of Anatomy, Yale University School of Medicine.

Observations on individual growth FRANZ BOAS

The significance and inheritance of leg length in dogs CHARLES R STOCKARD

Conceptual categories in primitive languages EDWARD SAPIR (introduced by C Wissler) The relation between language and experience is often misunderstood Language is not merely a more or less systematic inventory of the various items of experience which seem relevant to the individual, as is so often naively assumed, but is also a self contained, creative symbolic organization, which not only refers to experience largely acquired without its help but actually defines experience for us by reason of its formal completeness and because of our unconscious projection of its implicit expectations into the field of experience In this respect language is very much like a mathematical system, which, also, records experience, in the true sense of the word, only in its crudest beginnings but, as time goes on, becomes elaborated into a self-contained conceptual system which previsages all possible experience in accordance with certain accepted formal limitations Such categories as number, gender, case, tense, mode, voice, "aspect" and a host of others, many of which are not recognized systematically in our Indo European languages, are, of course, derivative of experience at last analysis, but, once abstracted from experience, they are systematically elaborated in language and are not so much discovered in experience as imposed upon it because of the tyrannical hold that linguistic form has upon our orientation in the world Inasmuch as languages differ very widely in their systematization of fundamental concepts, they tend to be only loosely equivalent to each other as symbolic devices and are, as a matter of fact, incommensurable in the sense in which two systems of points in a plane are, on the whole, incommensurable to each other if they are plotted out with reference to differing systems of coordinates The point of view urged in this paper becomes entirely clear only when one compares languages of extremely different structures, as in the case of our Indo-European languages, native American Indian languages and native languages of Africa.

The genesis of cerebellar tremor and its disappearance after removal of the cerebral hemispheres J F FULTON (introduced by Yandell Henderson) One of the most striking locomotor disturbances encountered in the field of clinical neurology is the tremor associated with lesions of the cerebellum Though recognized as the essential symptom of cerebellar deficit as early as 1824 (Flourens), its nature has remained obscure We have therefore focused our attention upon the genesis of tremor following removal of the cerebellum (cats, dogs, monkeys and baboons) and have found that in the cat it does not appear until the fourth to the seventh day after the operation Simultaneously with the appearance of the tremor, the animal commences to execute voluntary movements In other animals in which tremor appears sooner, it is always coincident with the return of voluntary activity Since the cerebellum had been removed the question arose as to what part of the nervous system was responsible for the tremor On removal of one cerebral hemisphere in the decerebellated animal the extremities of the opposite side become rigid but continue to show associated movements unaccompanied by tremor When the second cerebral hemisphere is removed, thus making a decerebellated thalamic preparation, great locomotor activity is seen in all extremities, but tremor is completely absent We have thus far succeeded in keeping preparations of this character under observation for periods varying from one to three weeks Further observations are being made on primates, in which the relation of the neocerebellum to the motor cortex is being studied. We conclude that cerebellar tremor is a phenomenon resulting from inadequate compensatory action of the cerebral hemispheres

The rate of trophic impulses in nerves of cold blooded vertebrates G H PARKER and V L PAINE. The lateral-line nerve of the catfish transmits sensory impulses in one direction and trophic impulses in the opposite The rate of transmission of the trophic impulses is very slow, approximately two centimeters per day

(*To be continued*)

BOOKS RECEIVED

JOHNSTONE, JAMES and R J DANIEL. *Report for 1930 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool* Pp 115 University Press, Liverpool 5s

ROWAN, WILLIAM *The Riddle of Migration* Pp. xiv + 151. Williams & Wilkins. $2.00

WILLIAMS, FRANCIS X. *The Insects and Other Invertebrates of Hawaiian Sugar Cane Fields.* Pp. 389. Illustrated Experiment Station of the Hawaiian Sugar Planters' Association, Honolulu.

SCIENCE

Vol 74 | Friday, December 11, 1931 | No 1928

New Contributions in Sterol Metabolism Professor Rudolf Schoenheimer 579

National Parks in Africa Dr. Mary L Jobe Akeley 584

Scientific Events
Daniel Gabriel Fahrenheit, Field Expeditions of the Oriental Institute of the University of Chicago, Sixth International Congress of Genetics, Research Exhibits of the American Association at New Orleans 588

Scientific Notes and News 591

Discussion
Cyclone and Anticyclone Professor Alexander McAdie. *The Uncertainty Principle* Professor William A Noyes *The Uncertainty Principle and Free Will* Professor Henry Margenau *The Classification of Pythium* Dr Christos P Sideris *"Taste Deficiency" for Creatine* Professor Roger J Williams 595

Scientific Books
Bailey's History and Work of Harvard Observatory, 1839–1927 Frederick E Brasch 598

Scientific Apparatus and Laboratory Methods
A Method for the Study of Chromosomes in Entire Insect Eggs M Louise Schmuck and Professor C W Metz *Reconstruction Work by the Use of Cellophane* E R Van Der Jagt ... 600

Special Articles
Simultaneity in the Onset of Poliomyelitis Dr Simon Flexner *Primitive or Filterable Forms of Bacteria* Professor James M Sherman and C E Safford *Diamagnetism in Metal Crystals* Dr Alexander Goetz and A B Focke - 601

The National Academy of Sciences II 604

Science News 10

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

NEW CONTRIBUTIONS IN STEROL METABOLISM

By Professor RUDOLF SCHOENHEIMER

UNIVERSITY OF FREIBURG

It is only a relatively short time since we assumed that plants only could synthesize complex compounds whereas animals were forced to obtain these complex compounds indirectly from plants and that in modifying these complex compounds for their specific needs only slight chemical changes are necessary

One of the most complicated substances in the animal body is cholesterol It is a hydroaromatic secondary alcohol with 27 carbon atoms containing two combined six carbon-rings, one five carbon-ring, a side chain and one double bond

It is, therefore, not surprising that this knowledge of the constitution of cholesterol led to the assumption that the animal body was forced to obtain this or a similar substance from plants because we could not conceive of synthetic activities of that order in animal tissues However, cholesterol-balance studies by various authors (Thannhauser, Bürger, Beumer, Randles and Knudson) indicated that at least under certain special conditions, animals also possess the power to form cholesterol because they sometimes found a negative balance in their metabolism studies, that is, they sometimes found more sterol excreted than consumed

These observations left unanswered the question of whether all the cholesterol present in the animal body was due to a synthesis in the animal body or whether the major part did not after all come from vegetable food The conversion of plant sterols into cholesterol in the animal body requires that the plant sterols which differ chemically from cholesterol must be absorbable, a question which up to the present has not been investigated in detail

The only phase of sterol absorption in the animal body known up to the present time is that of the absorption of animal cholesterol. Considerable evidence in favor of this view had been accumulated.

---

[1] Alpha Omega Alpha lecture delivered in Cleveland, February 27, 1931. These studies were in part aided by a grant from the Douglas Smith Foundation for Medical Research, University of Chicago.

A somewhat crude but very significant observation in this connection is the so-called experimental atherosclerosis in rabbits. These animals which are accustomed to a purely vegetable diet are very sensitive to the addition of cholesterol to their diet, in that one observes after a certain experimental dietary period morphologically visible deposits of cholesterol and cholesterol esters in various organs and especially in the aorta, a change which presents a most remarkable resemblance to the human atherosclerosis. The aorta of the rabbit is especially sensitive toward the oral administration of cholesterol), because even the daily feeding of a few milligrams if continued over a longer time leads to such deposits (Anitschow)[2]

If the above referred to theory of the simple conversion of plant sterols into the animal cholesterol were correct every rabbit should show a marked atherosclerosis, because the quantity of plant sterols present in the usual feed of rabbits is approximately ten times as high as the dose of cholesterol which calls forth an atherosclerosis It is, however, a fact that a true spontaneous atherosclerosis with deposition of cholesterol has never been observed in rabbits in spite of the most painstaking investigations This difference between theory and fact lead to our investigations on plant sterols

Although practically only one sterol is found in animal tissue we, nevertheless, find a great number of different sterols in plants, these usually occur in mixtures and are separated from each other with great difficulty Cholesterol does not even occur in traces in plants The most commonly occurring plant sterol, which is never absent in higher plants, is sitosterol which has the same elementary formula as cholesterol, has almost identical chemical properties and which, according to Windaus,[3] is a stereo-isomer of cholesterol

Our first experiments were carried out with sitosterol, of which larger amounts were available. We have fed enormous doses of sitosterol over long periods to rabbits and other animals, which would have suffered most severe pathological changes if cholesterol had been given instead, but the animals remained healthy and showed not even the slightest change[4] The chemical examination of these animals showed that they contained no more cholesterol than the normal ones while those fed on cholesterol contained approximately twice the amount The blood cholesterol concentration which is very much increased by cholesterol feeding remained normal in the sitosterol fed animals throughout the entire period. We have, furthermore, separated the total sterols from animals which were kept for almost one year on the sitosterol containing diet and have examined these sterols by Böhmer's method for sitosterol, which would detect concentrations of about 2 per cent. sitosterol. However, no sitosterol was found[5]

Furthermore, feeding experiments on rabbits with quantitative collection and analysis of the feces showed within the experimental errors of the method that the sitosterol fed is completely excreted in the feces while the food cholesterol is similarly recovered only to the extent of about 50 per cent[6]

All these experiments made it appear probable that the plant sterols are not absorbable just as we had assumed, but it was by no means still impossible that they may have been absorbed, then rapidly changed to cholesterol but followed by a very rapid excretion so that we would not be able to find them in the animal tissues by our method. If this were the case one would have found in part cholesterol or one of its derivatives in the feces from the plant sterol fed animals, because plant sterols do not occur in animal tissues We have, therefore, examined the excreta of various animals when kept on a purely herbivorous diet[7] Rabbits were kept on the usual diet of hay and beets from which a well characterized sterol mixture could be separated From the feces the same sterol mixture could be recovered, that is, this plant sterol mixture had passed through the alimentary tract without being altered qualitatively or quantitatively.

Later more exact studies were carried out which very specifically prove that plant sterols are non-absorbable.[8] A large part of the food, especially the fats and lipins, after absorption pass through the thoracic duct When an absorbable sterol, such as cholesterol, is fed it can be found in large amounts in the thoracic duct lymph. The examination of the thoracic duct lymph during the absorption period, is, in spite of the experimental difficulties, nevertheless the most ideal and safest method for determining the absorbability or non-absorbability of a sterol. One adds to the sterol to be tested a definite amount of the easily absorbable cholesterol and then one attempts to determine quantitatively the cholesterol as well as the other sterol content in the thoracic duct lymph. The relative proportions of the two sterols found will indicate how much more difficultly the other sterol is absorbed. This method is, of course, applicable only to those substances which can be quantitatively determined in presence of cholesterol. Unfortunately this is not true in all cases. In such cases special methods had to be devised, the discussion of which I can not go into in this brief review[9] Our lymph studies uniformly showed that we obtained only pure cholesterol in the lymph when a mixture of cholesterol and plant sterols was fed.

---

[2] Anitschkow, *Virch Arch.*, 249, 73, 1924.

[3] Windaus and Hahlén, *Ztschr. Physiol Chem.*, 101, 223, 1918

[4] Schoenheimer and Yuasa, *Ztschr. Physiol. Chem.*, 180, 5, 1929.

[5] Schoenheimer, *Ztschr Physiol. Chem.*, 180, 16, 1929.

[6] Schoenheimer, *Ztschr. Physiol. Chem.*, 180, 24, 1929.

[7] Schoenheimer, *Ztschr Physiol. Chem.*, 180, 36, 1929.

[8] v Behring and Schoenheimer, *Ztschr. Physiol. Chem.*, 192, 97, 1930.

From these studies one can definitely conclude that plant sterols are non-absorbable and it is, therefore, not surprising that rabbits remain normal after being fed of these substances. The results, however, also lead to the conclusion that animals which live on plants only and therefore never consume the absorbable cholesterol, are forced to synthesize their entire cholesterol necessary for their tissues[10] Similarly since the carnivorous animals receive cholesterol directly from their food and always in the last analysis from an herbivorous animal which synthesizes its own cholesterol, we can conclude that all cholesterol is a synthetic product produced in the animal body and that a sharp biological division exists in the sterols of the plant and animal kingdoms

However, all these experiments involved the use of chemical methods which introduce slight experimental errors For this reason, we could not exclude the possibility that we might, nevertheless, have absorbed and deposited the minutest traces of plant sterols which were not detectable by our methods

This is further suggested by the fact that throughout the animal organism one always finds with the cholesterol a slight trace of ergosterol which, in spite of the very small amount present, is of great biological importance, because it assumes antirachitic activity after exposure to ultra-violet light The ergosterol found in the animal body is regarded as a plant sterol and its occurrence in the animal organism was explained on the assumption that it is absorbed from vegetable foods and then transported to the tissues

We finally also investigated the behavior of ergosterol, mainly because its detection with the aid of its absorption spectrum and the biological method is 1,000 to 10,000 times more sensitive than that of the other plant sterols. In such a case even a very, very slight absorption would not escape detection The optical determination of the preparations separated by us were very kindly carried out through the courtesy of Professor Windaus in Göttingen, who also aided us in many other phases of our work We fed rats, mice and rabbits for a long period with perfectly pure ergosterol which was entirely free from the activated form and possessed no antirachitic action The feeding as well as the isolation of the sterols was carried out in the dark It was found that the ergosterol fed animals yielded body sterols with no higher content of ergosterol than those from the unfed animals.

The above is in the strictest sense not final evidence of the non-absorption because we obviously determined only the possible storage of ergosterol For that reason, the thoracic lymph was examined also.[11] Dogs were given a fatty meal to which were added one gram pure ergosterol and one gram pure cholesterol The cholesterol preparation separated from the lymph was found to contain less than 0 02 per cent ergosterol, a concentration which is less than that found in most cholesterol preparations. If the cholesterol and ergosterol had been equally well absorbed, the cholesterol preparation obtained from the lymph should have had about 2,000 times the observed ergosterol content. This experiment hardly permits of any other interpretation than that unirradiated ergosterol is not absorbable and that the exceedingly low concentration of ergosterol found in the thoracic duct lymph must have originated from other sources since the thoracic duct carries fluids from other sources than the digestive chyle To be sure our experiments are not absolutely fool proof They show, however, that ergosterol is absorbed only very slightly, so slightly that the very sensitive method used does not detect it One can, however, not exclude the possibility that vanishingly small but biologically important amounts of ergosterol may, nevertheless, be absorbed over a long time period. The question as to whether the animal body may also be able to synthesize its own ergosterol I shall discuss later.

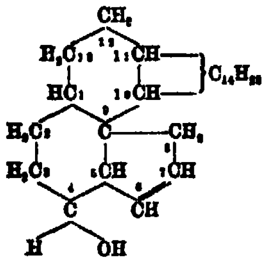
I have specifically referred to non-irradiated ergosterol, that is, not to the irradiated biologically active form which is also referred to as vitamin D There is no doubt whatever that the irradiated form is very easily absorbed, otherwise it could not show its vitamin action and when fed in large doses even show toxic action However, the irradiated ergosterol is a very different substance chemically from the non-irradiated form, in fact, we know that it is a stereoisomer The fact that unirradiated ergosterol is absorbed with great difficulty or, not at all, while the irradiated form is very easily absorbed, leads to the same relationships as in the case of cholesterol and sitosterol which are also considered to be stereoisomers and where the one is easily absorbed and the other is not absorbable. In the course of our investigations we have thus opened up a field which shows that absorbability in the case of sterols is dependent upon chemical constitution and that even slight changes in the molecular structure are sufficient to render an absorbable substance completely nonabsorbable As a result, we have undertaken a systematic study involving experiments on derivatives of the easily absorbed cholesterol[9] We studied only those substances in which only very slight changes in molecular structure are involved and in which the sterol character is still present, because we knew that even the slightest structural changes influenced absorbability

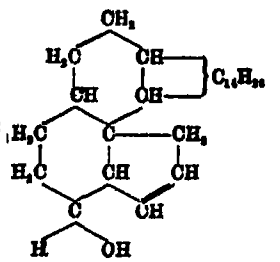
---

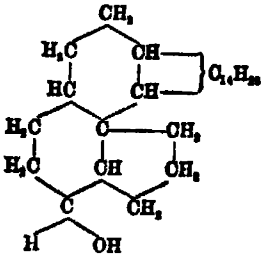
[9] Schoenheimer, v. Behring and Hummel, *Ztschr Physiol. Chem.*, 192, 117, 1930.

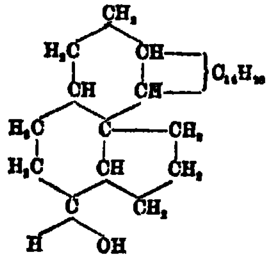
[10] Schoenheimer, *Ztschr. Physiol. Chem.*, 185, 119, 1929.

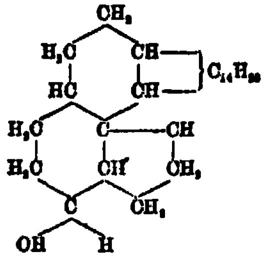
[11] Schoenheimer and v. Behring, *Klin. Woch.*, 9, 1309, 1930.

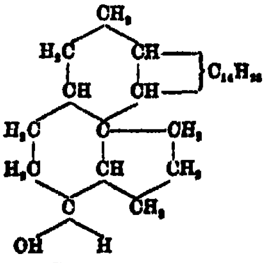
1.

Cholesterol

2

Allocholesterol

3.

Dihydrocholesterol

4.

Koprosterol

5.

E—Cholestanol

6

Pseudokoprosterol

The formulae above indicate the derivatives we have studied In addition to cholesterol there occur in the animal body two derivatives, these occur in the feces and are sterols in which the unsaturated bond of cholesterol has been saturated by hydrogenation These two substances, which I shall refer to again later, are koprosterol and dihydrocholesterol, two isomers which differ from each other only in a cis-trans-isomerism of carbon atom No 1 The dihydrocholesterol is obtained directly from cholesterol by the addition of hydrogen while koprosterol is related to allocholesterol, in which the same isomerism exists with reference to carbon atom No. 1 and which was prepared only recently by Windaus. This substance is exceptionally labile in that it readily rearranges into cholesterol under the influence of heat or of dilute acids. For these reasons we must take into account in feeding experiments with allocholesterol the possibility of the acidity of the gastric contents converting a part thereof into cholesterol and thus rendering it absorbable The comparative absorption studies on cholesterol and allocholesterol showed that the latter is absorbed much more difficultly than cholesterol (about one half to one third as much). It is, however, by no means impossible that the absorbed allocholesterol actually was first converted into cholesterol in the stomach

The other derivatives of cholesterol, especially those which also occur in the organism and which can be separated in traces from cholesterol also were nonabsorbable even in traces

These observations then led to the conclusion that the organism behaves in an exceptionally specific manner in the absorption of the sterols Even isomerism suffices to alter the absorbability and the saturation of the unsaturated bond changes the easily absorbable body to a completely unabsorbable form

An absorption, which is so specifically dependent upon molecular structure, has previously not, to my knowledge, been systematically investigated The observations led to an approach at interpreting the difficult or non-absorption of sitosterol and unirradiated ergosterol and the ease with which cholesterol and irradiated ergosterol pass through the intestinal wall

We have also extended our investigations to the consideration of the waste products or, better stated, the products of intermediary metabolism of cholesterol, a field regarding which almost nothing was known up to the present. I pointed out that cholesterol does not appear as such in the feces but as the two saturated forms, koprosterol and dihydrocholesterol The former of these occurs in far greater amounts.

The general view held up to the present as to the formation of these bodies was that the cholesterol from food, bile or digestive juices enters the intestines and is there converted into these products by the action of intestinal bacteria We have here under consideration a reaction involving hydrogenation, that is, a reduction, a reaction long known to be easily produced by intestinal bacteria, as for instance the conversion of the unsaturated bilirubin into the saturated urobilin-like body Although the conversion of bilirubin into urobilin has been successfully carried out *in vitro* by putrefactive organisms, all attempts by others as well as by us[12] with the *in vitro* conversion by bacteria of cholesterol into koprosterol and dihydrocholesterol have led to negative results.

In order to clarify the origin of these saturation sterols we undertook another method of attack. We, contrary to the earlier investigators, postulated that the saturated sterols did not originate in the intestines but that they represent intermediate products of metabolism, that is, that they are formed in the tissues themselves and are excreted into the intestinal contents For these studies it was necessary to develop a method which is sufficiently accurate to determine traces of these saturated sterols when mixed with cholesterol[13] This method is based upon the observation that all sterols form difficultly soluble addition compounds with digitonin but that the bromine derivatives of the saturated sterols, that is the cholesterol dibromide which is easily and quantitatively obtained by treating a solution of the sterol with free bromine, are no longer precipitable by digitonin Obviously one simply needs to treat the sterol mixture carefully with bromine and then the addition of digitonin precipitates only the saturated sterols originally present because the absence of the double bond prevents the formation of bromide derivatives of the saturated sterols

---

[12] Schoenheimer, v. Behring, Hummel and Schindel, *Ztschr Physiol. Chem.*, 192, 73, 1930.

With this method we could, to our surprise, establish the fact that all cholesterol preparations, immaterial from what animal or human organs they are obtained, contain such saturated sterols, usually small in amount[14] In most cases not more than two to three per cent is present, but none of the sterol preparations were found free from these substances The fact that these substances are present in such small amounts explains why they were not detected before

We succeeded in separating these saturated sterols in pure form by working with large quantities of the various cholesterol preparations[15] We expected, of course, that we would find a mixture of a composition very similar to that found in feces, that is, a mixture of koprosterol and dihydrocholesterol with the former in great excess. Contrary to these expectations we found only pure dihydrocholesterol and no trace of koprosterol could be detected

The same observations were made on plant sterols All available plant sterol preparations contained in addition to the main component, the unsaturated sterols, varying amounts of saturated sterols It appears, therefore, that the occurrence of sterols as mixtures of the saturated and unsaturated kinds is a common biological observation.

Naturally our first studies were on animals Where do the saturated sterols originate? I have already stated that these substances which always occur in large amounts in the intestinal contents are non-absorbable and are not, as we assumed formed in the intestines by the action of bacteria on cholesterol There is, therefore, no other explanation left for us than to state that the dihydrocholesterol is formed in the tissues by the hydrogenation of the cholesterol and that it is to be considered a product of cholesterol metabolism

The real question next was by what path does dihydrocholesterol thus formed in the body pass into the intestines? Formerly it was assumed that the main part of the cholesterol from the body passed to the intestines by solution in the bile Therefore, it was necessary to assume that very likely gall stone cholesterol would also contain very large amounts of dihydrocholesterol We found, however, only very small amounts. The calculations then indicated that still another source must exist Sperry[16] some time ago showed that the intestinal wall is permeable to lipoids and that we have excreted with them some cholesterol We, therefore, suspected that the sterol thus excreted probably was not cholesterol at all, but dihydrocholesterol instead

In order to prove this we found it necessary to carry through the isolation of sterols from large amounts of sterile intestinal secretion, an undertaking which presented tremendous experimental difficulties. The following procedure was found satisfactory[17] We sectioned the small intestine of a dog above the large intestine and sewed the lower end of the small intestine to an opening in the abdominal wall The isolated end of the intestine which was still united to the anus was rinsed with many liters of water until the washings were obtained perfectly clear, then the upper end of this intestinal section was lighted The blind intestinal section thus consisted of the large intestine and a small part of the small intestine and still connected to the anus After two days this intestinal preparation was rinsed daily from the anus with warm water After about eight days of such treatment the rinsings from this intestinal preparation were found almost sterile. If the anus was now closed by operative procedure the antibacterial action of the intestine was sufficient to destroy the remaining microorganisms

After one to two months the animal was sacrificed and the contents of the intestinal preparation recovered The content was very interesting. In most cases it was completely sterile. Usually we obtained per day 60 to 70 grams of a light yellow, wax-like mass, the surface of which presented in relief the character of the mucous membrane of the intestine. We have no doubt that we have here the normal dried intestinal secretion which normally would be mixed with the feces and therefore would escape detection. It has only a small water content and all reabsorbable substances, including cholesterol, must have been reabsorbed, that is, we have here those substances which are secreted but not reabsorbed. From these masses of material we could separate very significant amounts of dihydrocholesterol, but koprosterol was not found

---

[13] Schoenheimer, *Ztschr. Physiol Chem.*, 192, 77, 1930.

[14] Schoenheimer, v. Behring and Hummel, *Ztschr Physiol. Chem.*, 192, 93, 1930.

[15] Schoenheimer, *Ztschr. Physiol. Chem.*, 192, 86, 1930.

[16] Sperry, *Jl. Biol. Chem.*, 82, 560, 1929; *ibid.*, 85, 455, 1930.

[17] Schoenheimer and v Behring, *Ztschr. Physiol. Chem.*, 192, 102, 1930.

As a result of these observations we had proved that the dihydrocholesterol after its formation in the tissues actually is secreted through the intestinal wall This clarifies the metabolism of dihydrocholesterol but not of koprosterol Since koprosterol was not found in the tissues but always in larger amounts in the feces, we must still assume that it is a product of the bacterial action in the intestines even though we have not been able to reproduce the same *in vitro* We must consider that up to the present it has not been possible to cultivate all of the intestinal bacteria and it is very probable that any one of the difficultly cultivatable anaerobes may be able to bring about this change It is hoped that the near future may throw light on this question

To us the most important question now appeared to be, what is the significance of this intermediary hydrogenation which leads to the formation of dihydrocholesterol in the animal? The question may also be formulated to read What is the source of the hydrogen which leads to the hydrogenation of the double bond in cholesterol? In view of this process existing in both animals and plants we must conclude that we have under consideration a general biological process in which the cholesterol functions as hydrogen acceptor According to the Wieland dehydrogenation theory, it was necessary to assume that this hydrogen originated from other organic substances which yield hydrogen and thus became unsaturated. This hydrogen yielding substance was expected to be found among the other lipoids associated with which cholesterol occurs in nature

Since the amount of dihydrocholesterol formed daily is very small, a working hypothesis was advanced that the formation of dihydrocholesterol is associated with the formation of fat soluble, highly unsaturated, but biologically very active substance Such a substance, for example, would be ergosterol which possesses a structure very similar to cholesterol, but which has three double bonds instead of one as in cholesterol. I stated that ergosterol is very difficultly, if at all, absorbable and since it is present in all animal tissues it led to the view that animals as well as plants possess the power of forming the ergosterol. If this is the case, then it is also possible that we might have formed simultaneously from cholesterol both dihydrocholesterol and an ergosterol-like body.

Recently Koch, Koch and Kraus-Ragins,[18] carried out a very illuminating experiment When cholesterol, freed from the last traces of ergosterol, was heated at a high temperature without access to oxygen, a new substance was obtained which, after irradiation by ultra-violet light, possesses antirachitic activity.

We have modified these experiments for our purposes and have worked with cholesterol preparations which were not only free from the last traces of ergosterol but also of dihydrocholesterol[19] When these preparations were heated to high temperatures in a high vacuum with a complete exclusion of oxygen there was obtained a small amount of a saturated sterol which very likely is dihydrocholesterol At the present time we have only a very small amount of this difficultly obtainable substance, so that we have not been able to identify it accurately The formation of this saturated sterol and of the antirachitic body can, however, not be explained in any other way than to suppose that a small part of the cholesterol has been converted by dehydrogenation into an ergosterol-like body with the probable introduction of two new double bonds and that at the same time there is formed in another part of the cholesterol a completely saturated sterol due to the liberated hydrogen.

We have not always succeeded in carrying out this reaction because it appears that a catalytic agent may be involved This reaction makes it appear very probable that the animal body may also be able to carry out a similar process and that the dihydrocholesterol found by us is in fact associated with the formation of the ergosterol. This interpretation must, however, be confirmed by further experimentation.

In this lecture I have referred only to the most obvious results of our work. On account of lack of time I have unfortunately not been able to discuss the methods which are so very important in all experimental work and serve as a basis for a critical evaluation.

NATIONAL PARKS IN AFRICA

THE EXTENSION OF WILD-LIFE CONSERVATION

By MARY L. JOBE AKELEY, A.M., Litt.D.

SECRETARY OF THE AMERICAN COMMITTEE FOR THE PARC NATIONAL ALBERT

The first national park created in the great continent of Africa is the Parc National Albert, established by royal decree of Albert, king of the Belgians, in 1925. Here, in the Kivu District of the Belgian Congo, are found the rare mountain gorilla (*gorilla berengei*), to-day of increasing scientific importance. Living side by side with the gorilla on the cool wooded slopes of the extinct volcanoes, Mikeno, Karisimbi and Bishoke, are leopard, elephant and buffalo. Pygmies, still primitive and unspoiled by the white man, dwell in the lower reaches of the gorilla forest. Along the shores of Lake Edward and on the nearby sandy plains (areas added in 1929), are herds of antelope such as are found in British East Africa. Great herds of hippo frequent not only Lake Edward but also the slow-flowing Rutshuru River Now that this first national park has become a reality, Belgian conservationists are planning to increase their sanctuaries for conservation and research in the Belgian Congo Parc National Albert will be followed by two new Congo park projects, Parc Leopold and Parc Ruwenzori

---

[18] Koch, Koch and Kraus-Ragins, *Jl. Biol. Chem.*, 85, 102, 1929.

[19] Schoenheimer, *Naturwissenschaften*, 18, 361, 1930.

Immediately after his 1921–22 expedition for the American Museum of Natural History, the naturalist and conservationist, Carl Akeley, called the attention of scientists as well as of nature lovers to this remote and beautiful part of the world. While securing there a group of gorillas for a natural history exhibit for African Hall, he was unwilling to take any life needlessly He collected only five—one half the number of specimens permitted him by the Belgian Government—because he believed this number sufficient to serve his scientific purpose While observing the gorillas at close range, he became impressed by the non-combative nature of these animals when undisturbed by man. He also was greatly surprised by the small number of gorillas inhabiting the forests of the extinct volcanoes, Mikeno, Karisimbi and Bishoke, in which they had been reputed to be plentiful He knew that many "mighty hunters" of big game were at that time eager to hunt and kill gorillas in order to have a new sport and new trophies Since he believed it would be an easy matter to exterminate the whole colony because of the nature of the gorilla and because of the scarcity of the animal, he began to advocate a gorilla sanctuary for the protection of the great ape as well as of all other wild life, both plant and animal. Of the greatest importance to his project were Mr. James Gustavus Whiteley, Belgian consul general at Baltimore, and Dr John C Merriam, president of the Carnegie Institution of Washington, who recommended this gorilla sanctuary plan to Baron Emile de Cartier de Marchienne, then Belgian ambassador to the United States. The ambassador took it directly to King Albert, who was so impressed by the desirability of the measures advocated that he created the Parc National Albert in 1925.

Shortly after the Parc was established, my husband requested Belgian permission, through Baron de Cartier, to return to the Congo. To secure studies for a painted background and accessories for the Gorilla Group and to carry on initial investigations of the gorilla in his native haunt were the objects of our 1926 expedition to the Kivu—the Akeley-Eastman-Pomeroy African Expedition for the American Museum of Natural History. On our way to Africa in February, 1926, my husband and I went to Brussels, where we were entrusted with the royal mission to the Kivu, which empowered us to execute a general survey of the new national park Later we invited Dr. J. M. Derscheid, zoologist and cartographer of Brussels, to join us in Africa to assist with this survey. After my husband was called to the Great Beyond, three days after we reached his 1921 camp in the gorilla forest, Dr Derscheid rendered invaluable service to our expedition so that we fulfilled the Belgian royal mission On my return to Europe, I was requested by King Albert to give him personally a preliminary account of the results of our expedition In Brussels in 1928, Dr Derscheid and I prepared our report and our recommendations for the Belgian Government concerning the future of the Parc National Albert. According to the original decree, the park was limited to a triangular area comprising the three extinct volcanoes, Mikeno, Karisimbi and Bishoke We now proposed that this area be extended so as to include Nyamlagira and Nyiragongo, active volcanoes of importance to geologists and seismologists, that it should include the southern shore of Lake Edward and the Rutshuru River, where animal life is abundant, that certain native villages and arable lands be excluded in order to avoid any future conflict between native rights and the economic development of the country on the one hand and the interests of science on the other, and, for the promotion of scientific research, that there should be established a central station for research and administration, including laboratories, library and study museum, and also that ranger stations should be built throughout the park. In conclusion, we recommended that the management of the park be placed in the hands of a scientific institution so favorably situated as to obtain financial and scientific help both in Belgium and in foreign countries

King Albert received us at the Royal Palace on October 8, 1928. There, our report was submitted and throughout a long and interesting evening the future of the park was discussed. Subsequently, the royal decree of May 6, 1929, increased the park domain to 500,000 acres, according to our proposals, and provided therein for the preservation of all fauna and flora for strictly scientific purposes. The decree also stipulated that the park is to be administered by the *Commission du Parc National Albert* and by a committee of direction His Highness Prince Eugene de Ligne was named president. In the park, it is forbidden, under penalty of penal servitude, or fine, or both, to pursue, capture, kill or molest in any way any kind of wild animal, including animals which are reputed harmful, to take or destroy the eggs of wild birds, to cut down, destroy or remove any uncultivated plant, or to make any excavation, embankment, boring or any operation of a nature to change the aspect of the ground or of the vegetation Unless provided with a special permit, no one (except officials and others properly qualified) may enter the park, or circulate, camp or sojourn therein, or introduce dogs, traps or firearms, or possess or transport or export skins or other parts of wild animals, or uncultivated vegetable products. Lands now occupied by natives or private persons are to be expropriated. Even on these tracts under private or native occupation, the destruction, capture or pursuit of the gorilla as well as all forms of hunting this animal are absolutely forbidden

Around the park proper is a zone of protection. In it cutting down trees, hunting and fishing are prohibited The few natives who live therein will not lose their hereditary rights, but they may employ only their primitive weapons. The Belgian Government will pay the strictly administrative expenses of the park, maintaining a corps of conservators and native police

In October, 1929, King Albert formally installed the *Commission du Parc National Albert,* a body of eighteen scientists chosen from England, Sweden, the United States, France, the Netherlands and Belgium. In his address at the *Palais des Académies,* Brussels, His Majesty described the park as unique because of its widely diversified scientific opportunities He emphasized the varied aspects of the region, "which are of interest not only to geologists and mineralogists, but which are remarkable from the point of view of ethnography as well, since Bantu and Hamitic tribes as well as pygmies (Batwa) are simultaneously present"

In 1930, the American Committee for the Parc National Albert was formed to cooperate with the International Committee in the matter of scientific research His Highness, Prince Albert de Ligne, at that time Belgian ambassador at Washington, who from the beginning has been most active in forwarding the plans for the park, was named by His Majesty chairman of the American Committee, Mary L Jobe Akeley was appointed secretary In addition to the two American members of the International Commission, Professor Henry Fairfield Osborn and Dr John C Merriam, the Prince de Ligne subsequently appointed as members of the committee Mr Stanley Field, president of the Field Museum of Natural History, Chicago, Dr. Vernon L. Kellogg, of the National Research Council, Washington, Dr Robert M. Yerkes, of Yale University, Dr. George W. Crile, of Cleveland; Dr. Lewis H Weed, of Johns Hopkins University, Baltimore, and the Hon. James Gustavus Whiteley, Belgian consul general at Baltimore.

At a meeting of this committee, in December, 1930, at the American Museum of Natural History, New York, the Prince de Ligne, who was leaving America shortly thereafter to take up his duties as Belgian ambassador at Rome, resigned his office. Dr. Merriam was elected president to succeed him At this time, it was decided to enlarge the American committee in order to afford a national representation Subsequently Senator Frederic C Walcott and Mr George D Pratt were elected as new members, and more recently, Dr William K Gregory, of Columbia University The committee's purpose now is to bring the Parc National Albert and other similar undertakings in Belgian Africa in closer contact with American scientific and conservation organizations, as well as to secure support for these projects.

Dr J M. Derscheid, now *administrateur-général* of the park, present at this meeting, reported the progress of the Kivu park as well as detailed plans for the further extension of the park system in Belgian Africa. The newly projected Parc Leopold, near the northern border of the Congo, will comprise an area of 1,000,000 acres Lying north and east of the Parc National Albert will be another new park, Parc Ruwenzori, adjoining the Belgian Congo-British Uganda boundary The Congo park areas will thus total 2,000,000 acres

Pending the official establishment of these new parks, activity has been concentrated in the Parc National Albert Patrols of native scouts are on guard to prevent the killing of any wild animal and the destruction of plant life Meanwhile the Belgian Government has appropriated funds for the maintenance of the park service, and has advanced a loan of two million francs, to begin immediate construction of a central station for scientific research This station will be erected on a grant of twenty acres in the heart of the government post at Rutshuru. Here will be the central library, containing a collection of all the scientific treatises relating to the fauna, flora and geology of Central Africa; a study museum, for which will be collected all the animals indigenous to the immediate vicinity, laboratories, equipped for the use of zoologists, botanists, seismologists and geologists Provision is being made for a chemical laboratory and a photographic wing. Nearby will be an assembly hall, administrative offices and living quarters All these buildings are designed for the use of white men unaccustomed to the tropics. Although only one degree from the equator, Rutshuru is white man's country because its 5,000 foot elevation lifts it out of the torrid zone.

This central station, moreover, is now connected with the outside world by a motor road to the Upper White Nile by way of Beni and Irumu—and thence by water and rail to the Mediterranean. Another road will soon connect with Kisumu, Uganda, and thence by train to Mombasa, the port of entry to Kenya Colony on the Indian Ocean. However, avenues of easy approach to this region will by no means result in letting down the barriers into the park so far as the outside world is concerned. One of the most important points in the scientific creed of the park is that therein the primitive shall be preserved! In addition to the general policy of absolute protection, certain designated areas will be kept wholly free from human intrusion, except as an emergency may demand.

Of especial significance in connection with international effort for immediate conservation are two recent addresses delivered in London—one by Major R. W. G. Hingston before the Royal Geographical Society on March 9, 1931, the other by Sir Peter Chalmers Mitchell on September 24, 1931.

Major Hingston recently returned from an African expedition which was approved by the Secretary of State for the Colonies and the Joint East African Board and at the request of the Society for the Preservation of the Fauna of the Empire. After visiting Northern Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda, he has prepared a scheme for ten British national parks for Africa. He says:

> Of all the assemblages of wild animal life that of Africa is by far the most important. In the abundance and variety of its constituents, in the immense size, the unique character, and what we must call the prehistoric appearance of its examples there is nothing to compare with it in any other continent. The elephant, rhinoceros, hippopotamus, giraffe, okapi, gorilla are perhaps the most impressive manifestations of the creative force that to-day exist on the earth. Fortunately it is an expression of general feeling that the final extinction of these extraordinary creatures would be a gigantic calamity. Nevertheless it is equally true that these and many other types of the African fauna can not under existing conditions hope to survive far into the future. It is as certain as night follows day that unless vigorous and adequate precautions be taken several of the largest mammals of Africa will within the next two or three decades become totally extinct. Should that occur then assuredly we shall have abused a trust and future generations will judge us accordingly.
>
> Every large animal of whose extinction we have any record has been eradicated by human agency. Confining ourselves to the African fauna, the great blaubok, which inhabitated Cape Colony, was annihilated by the farmers in the year 1800; the quagga, which covered the plains of South Africa, was exterminated by the Boers in 1858; the typical form of Burchell's zebra, which existed in British Bechuanaland, became extinct about the year 1910. Certain other species have been so reduced that they may be said to border on extinction. Take for instance the white rhinoceros. Within the lifetime of many of us still living the white rhinoceros abounded in the African continent from the Vaal to the Zambezi. To-day it is reduced to twenty individuals in Zululand and one hundred and thirty individuals along the upper reaches of the Nile. It has been exterminated over half a continent within a space of fifty years. The gorilla, nyala, Grevy's zebra are species which have shrunk to minute numbers and are on the verge of disappearance. The whole African fauna is steadily failing before the forces of destruction brought to bear against it. Great and small, everything is retreating. And the saddest aspect of the melancholy picture is that it is the largest and most extraordinary examples which are yielding most rapidly in the conflict. I doubt if any of the great pachyderms, the elephant, rhinoceros, and hippopotamus, will, if present conditions continue, survive beyond the next fifty years.

He enumerates the four forces causing the annihilation of wild life: (1) The spread of cultivation, (2) the demands of trade, (3) the activities of sportsmen, (4) the menace of disease.

Stating that the weak point of the game reserve is its insecurity and want of permanence, he continues:

> The national park, in contradistinction to the Reserve, is placed by legislation on a more stable basis. It possesses a title. It is made by Act of Parliament the property of the public forever to be utilized for the sole purpose of preserving the natural subjects within it. It can not be abolished or altered in any way except by subsequent Act of Parliament. This is the most secure and rigid status that can be given to a wild life sanctuary. It alone offers any reasonable hope that the sanctuary may last into the distant future.
>
> There are only two institutions in Africa which at present possess that likelihood of permanency implied in the status of a national park. One is the Kruger National Park of the Transvaal, established in the year 1926. The other is the Parc National Albert of the Belgian Congo, established in the year 1925. Both of these have some reasonable prospect of surviving the economic importunities of civilization. It is the belief of all who desire the perpetuation of the fauna that national parks on this rigid basis should replace the fluent reserves.

For the address of Sir Peter Chalmers Mitchell, I quote from an extract published by the London *Times* of September 25, 1931. The great naturalist reviewed the dangers threatening wild life in every part of the world, and which were increasing with the improvement of transport. "In most countries," he said, "the conscience of the people and of governments is being awakened to the danger, and much is being done, by game laws, the institution of closed times and the making of reserves. Unfortunately these measures are insufficient, and, as he had urged in an address to the British Association in 1912, it is of vital importance that large areas should be set apart for all time, secured against the sportsman and settler and prospector, preferably under international sanction, for the perpetual preservation of the plants and animals and natural beauties they contained. Since 1912 there has been a number of additions, of which the most important are the Kruger National Park, made by the Union Government of South Africa, and the Parc National Albert in the highlands of the Belgian Congo"

"The latter, both from its natural beauty and the animals it contained, he characterized as one of the most interesting in the world Among other animals it contains some of the few surviving gorillas in the natural surroundings which they have occupied for hundreds of thousands, possibly for millions of years Across the frontier in Uganda, in territory under British control, there is an area of a few square miles of exactly the same physical features, and occupied either permanently or occasionally by gorillas of the same variety For several years the Zoological Society of London, the Society for the Preservation of the Fauna of the Empire and other bodies and individuals have urged the Colonial Office to place this area on exactly the same terms of permanent security as the Parc National Albert The governor of Uganda has declared himself in favor of the proposal, and the Government of Belgium, through the ambassador in London, has begged that this should be done But the Colonial Office has remained apathetic or obdurate, putting off the decision on one ground or another It is much to be hoped that this blot may be removed from the reputation of Great Britain."

Obviously the future is full of difficulty and fraught with the gravest danger to wild life, but active effort among scientific men in both Europe and America will undoubtedly advance the movement for permanent conservation under fundamental law. Moreover, the preservation in certain areas of the primitive, wholly unaffected by the aggressive march of civilization, offers a rare scientific opportunity To accomplish this is now the spirit motivating many who now carry on the fight to save vanishing Africa. Theirs is not a sentimental interest It is a true understanding and a realization of the urgent need for action In Africa, at least, Carl Akeley's dream, now become a reality, has halted the juggernaut of mass destruction Belgium's whole-hearted action is epoch-making in the international possibilities of conservation and of scientific inquiry Such liberal and broad-minded policy will go far toward influencing other nations and cementing national friendships

Because the Parc National Albert offers an unparalleled opportunity for scientific investigation it is confidently hoped that interested laymen in America as well as elsewhere may forward the effort for the great central scientific station in the Belgian Congo Park Practical and sympathetic support will become not only a force contributing to the advancement of science, but it will be of material assistance in the fight for the conservation of wild life under conditions of unusual significance.

SCIENTIFIC EVENTS

DANIEL GABRIEL FAHRENHEIT

Daniel Gabriel Fahrenheit, inventor of the mercury thermometer, was a native of Danzig. There is some ground for suspecting that the family may have come originally from Konigsberg, in East Prussia. At any rate, numerous persons bearing this and similar names have been located there The letter printed below is translated from the German original, which is to be found in the town archives of Danzig It was called to the writer's attention by Dr Recke, the chief archivist of Danzig, who kindly consented to its publication in English. Dr Recke planned to publish it in its original form in the course of the present year (1931) in the *Zeitschrift des Westpreussischen Geschichtsvereins* The scheme of Fahrenheit's guardians to have their energetic young ward—then about twenty-one years of age—sent to the most remote of Dutch colonies did not materialize Except for occasional travels abroad, Fahrenheit remained in Amsterdam and The Hague until his death in 1736, and won his claim to fame in his adopted country. He appears to have begun the use of mercury for thermometers in 1720, and he reported his invention to the Philosophical Society of London in 1724 It may be of interest to note that whereas his own explanation was that he determined his zero point by the behavior of a combination of salt, ice and sal ammoniac, some German authorities insist that Fahrenheit's zero represents nothing else than the coldest day in Danzig in 1709! All accounts agree that the winter of that year was exceptionally cold. If the latter view is valid, this troublesome son of the Free City provides a curious link between Danzig—at its coldest—and that Anglo-Saxon world that has so persistently gauged its temperature by his device.

Mr. Burgomaster and honorable gentlemen [of the Danzig Town Council]:

We, who have been named as the guardians of the minor children of the late Danial Fahrenheit, have sent his son, Daniel Gabriel, a minor, to Amsterdam by his own consent, to serve in an office, in the hope that he would learn there to conduct himself properly. But things have gone very badly with this minor, he has spent the money given him, and he has behaved himself regrettably in other ways. So, in order to protect the interests of his brothers and sisters, we have been obliged to sequester a part of his capital, and have requested him through his patron to turn a new leaf. But he has paid no heed, he has resumed his former practices, so we have been put to not a little trouble and pains to try to bring about a change for the better in his mode of life, but without being able to do anything with him We have finally, on his own representation, decided to have him sent to the East Indies, for which purpose we dispatched him to Amsterdam a few weeks ago, and sent orders to a certain merchant [firm] by the name of Johannes Droogenhorst and Son to help him to a place with the East India Company, which was done. But when the time came for him to present himself, he failed to appear, and according to a report that has come in, he has gone to the bad again and resumed his former way of life Because we can see nothing ahead for him except destruction and dire ruin to his temporal well being, we guardians desire to report the situation to the honorable Council, as his supreme guardians, hoping that the Council with the help and advice of the authorities will support this modest expression of our opinion, and request (though we would not go contrary to the wishes of the honorable Council) that we be authorized to send full powers issued under the seal of the town to the said Droogenhorst and Son in Amsterdam, instructing them to locate him with the help of the authorities, place him under arrest, and send him to an appropriate place in the East Indies at the earliest opportunity In laying the matter before your honorable Council, we seek only the welfare of this minor, his present and eternal happiness, await a happy decision, and remain

Your honorable Body's dutiful servants

[signed] BRUNO PLANDERS
BENJAMIN HEDDING
DANIEL NUTZMANN

Authorized guardians of the minor son of the late Daniel Fahrenheit, who is called Daniel Gabriel

[Endorsement] Read in the Senate [of Danzig] January 21, 1707. The Council authorizes the guardians to send a full power to the person [*i e*, firm] mentioned in the petition through the Chancery here

WALDEMAR WESTERGAARD

UNIVERSITY OF CALIFORNIA
AT LOS ANGELES

FIELD EXPEDITIONS OF THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO

THE twelve field expeditions of the Oriental Institute of the University of Chicago follow a line of great ancient cities, Persepolis, Babylon, Bagdad, Nineveh, Aleppo, Megiddo and Jerusalem, Cairo and Luxor, through the Highland Zone, the Fertile Crescent and the Nile Valley, at strategic sites in the area where civilization first arose.

Their work is as follows:

The *Megiddo Expedition* is excavating the mound of Armageddon or Megiddo in Palestine, commanding the most famous battlefield of the ancient world The mound covers a stratified series of cities, which are now being laid bare. The work is in charge of Mr. P L. O. Guy.

The *Anatolian Expedition* is working in the eastern part of Anatolia, has surveyed the country of the ancient Hittites, and has done considerable excavating in a mound at Alishar Dr. H. H. von der Osten is in charge of the field work.

The *Iraq Expedition* is engaged in a ten years' program of excavation in Assyria and Babylonia. Last year Prof Edward Chiera excavated the Temple of Sargon II and discovered the temple of Sennacherib near Khorsabad, north of Bagdad Dr Chiera is to take charge of the Assyrian dictionary, and Dr. Henri Frankfort is now field director

The *Persian Expedition* is under the direction of Dr. Ernst Herzfeld. A party is working on the ruined palaces of the emperors Darius and Xerxes at Persepolis This is the first American scientific mission in Persia.

The *Syrian Expedition* is excavating a mound believed to be that of the ancient city of Calneh, referred to by the prophets Amos and Isaiah

In Egypt Architectural Survey Located at the Great Temple of Medinet Habu, built by Ramses III (1200 B. C) at ancient Thebes, opposite modern Luxor in Egypt This expedition is in charge of Professor Uvo Hoelscher

Epigraphic Survey Also at Medinet Habu, under the direction of Professor Harold H. Nelson It is preserving the inscriptions on the walls of the temple, which were perishing, by a process requiring photographers, artists and epigraphers, who produce a perfect facsimile. These records are to be published in six large volumes and distributed throughout the libraries of the world

Abydos Expedition Here the institute is saving the records of the beautiful temple of Seti I, the reliefs of which are among the finest works of art surviving from ancient times Headquarters of these three Egyptian expeditions are in Chicago House near Luxor, funds for which were contributed by Mr. Julius Rosenwald and the International Education Board.

Coffin Texts Project. This is located at Cairo Dr. Alan H. Gardiner, research professor of the University of London, and Dr. A DeBuck, have virtually completed the task of copying the texts, which were written with pen and ink on the inner surfaces of the wooden coffins in Egyptian burials, beginning as far back as the twenty-third century B C. and coming down to the eighteenth century B. C.

Sakkara Project. The institute will publish some five folio volumes of colored relief paintings from the great masonry tombs of the cemetery of ancient Memphis, fourteen miles from Cairo. The copying is being done under the direction of Professor Prentice Duell.

Theban Tomb Paintings Project Under the general direction of Dr Gardiner, Mrs N DeG Davis has long been engaged in copying the paintings on the walls of the tombs in the cemetery at Thebes These will also be published by the institute

Prehistoric Survey. This expedition is studying the prehistoric background of early civilization in Egypt and Asia Minor, and has carried on investigations of the geology of the Nile Valley The field director is Dr K S Sandford

THE SIXTH INTERNATIONAL CONGRESS OF GENETICS

DURING the past few weeks there has been agitation on the part of certain individuals in favor of postponing the Sixth International Congress of Genetics The council of that organization has been in prolonged and careful consultation on this matter and has decided that the congress should not be postponed

In coming to this decision the council has been particularly influenced by several important factors Among these may be listed the fact that in spite of adverse economic conditions a number of prominent foreign geneticists have already indicated their intention of attending the congress, a large number of lectureships which are available in American universities will undoubtedly provide honoraria for further foreign attendance, obligations already undertaken and commitments made to members and others interested, the distinct uncertainty of any marked improvement in the economic situation within any possible period of postponement, the already keen interest in the congress expressed by the great majority of American geneticists, and the inadvisability of postponing any international congress for reasons other than general war conditions

Now that the matter of postponement has been carefully considered and finally settled, it should be the welcome duty of all American geneticists and interested biologists to make even more than ordinary effort to cooperate in organizing and carrying through a successful congress As stated above, there is no doubt but that this result will be accomplished The object in making this statement is simply to settle the question in the minds of all interested

C. C LITTLE,
Secretary General

RESEARCH EXHIBITS OF THE AMERICAN ASSOCIATION AT NEW ORLEANS

THE American Association for the Advancement of Science is again offering the facilities of its annual meeting for holding exhibits in science The City of New Orleans has generously provided the exhibit space in its large Auditorium for non-commercial exhibits, on condition that these exhibits shall be open to the public. This exhibit space is provided with direct and alternating current, water and gas, and should therefore facilitate the setting up of active demonstrations both in pure and applied science. It is recognized that the progress in science is contingent upon the advance in material quite as much as the advance in the efficiency of warfare Moreover, the growing economic support of science is contingent upon a broad public appreciation of its value. The continued improvement in the quality of the army of workers is none the less dependent upon the general popular appraisal The council of the association believes that this public appreciation can be wisely augmented by objective presentations of the current works of scientific men and that willingness to exhibit may be taken as a democratic gesture on their part These exhibits have the hearty support of the press service of this association, of which Austin H Clark is chairman, as well as of Science Service, Howard Blakeslee, science editor of the Associated Press, and the other science editors Experience has taught these men the advantages of the objective approach to sympathetic understanding of the public at large

The exhibition of science at New Orleans, from December 28 to January 2, is an assured success in spite of the economic conditions and the resultant lateness in getting the organization for exhibition into operation Among the exhibitors who already have their work prepared are the Bureau of Standards, the Bureau of Mines, the scientific bureaus of the Department of Agriculture, the Coast and Geodetic Survey, the U S Public Health Service, the Corps of Engineers, U S Army, the U S Geological Survey, the Carnegie Institution of Washington, the Science Department of the "Century of Progress," Tulane University Museum and the Tulane Department of Geology, the American Institute of New York, the American Museum of Natural History, the School Nature League, the Rice Institute, Forest Products Laboratory, New York Botanical Garden, Southern Forest Experiment Station, Stanford University, George Washington University, the Entomological Society of America, the American Association of Economic Entomologists, the Society of Petroleum Geophysicists, the American Association of Physics Teachers, Professor Burton E Livingston, of the Johns Hopkins University, Professor Fred Allison, of Alabama Polytechnic Institute, Dr Sam F Trelease, of Columbia University, and Dr. John W Shive, of the New Jersey Agricultural Experiment Station

The Association is providing tables and wall space and supervision of the exhibits Those desiring to exhibit should communicate immediately with Dr. F. C Brown, chairman of the committee, at the office of the permanent secretary, Smithsonian Institution Building, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

The election of Dr. Vernon Kellogg as secretary emeritus of the National Research Council was announced by the executive board on December 9 following his resignation as permanent secretary, an office that he has held for the past twelve years from the time that the National Research Council began its activities on a peace-time basis. Dr. Kellogg's resignation is effective on December 31. The new position continues his work and affiliation with the National Research Council in an advisory capacity while he is relieved of administrative duties which his health does not permit him to perform.

Dr. Henry Norris Russell, professor of astronomy at Princeton University and director of the Princeton Observatory, was elected president of the American Philosophical Society at its meeting on December 4. The election was to fill the vacancy caused by the death of Dr. F. X. Dercum.

Chief Justice Hughes, chancellor of the Board of Regents of the Smithsonian Institution, will present on December 18 two awards of $2,500 each, given by the Research Corporation of New York to Dr. Andrew Ellicott Douglass, of Tucson, Arizona, and to Dr. Ernst Antevs. The prize is awarded to Dr. Douglass for his researches on the rings that mark the annual growth of trees which have thrown light on the past climate of the earth and on the correspondence between weather and solar activity. The award to Dr. Antevs was in recognition of his use of varves, layers of clay in ancient lake beds, as timepieces of glacial activity. Dr. Douglass and Dr. Antevs will each give a half-hour illustrated account of his principal researches.

Gold medals of the Radiological Society of North America were presented at the recent St. Louis meeting to Dr. Max J. Hubeny, of Chicago, for distinguished services in x-rays and radium, and to Dr. Carlos Heuser, of Buenos Ayres, for x-ray developments useful for studying the internal organs of women.

Professor J. Stanley Gardiner, of the University of Cambridge, has been elected an honorary member of the Boston Society of Natural History.

The German Society for Cancer Research has elected Dr. Frederick L. Hoffman, of Wellesley Hills, Massachusetts, to honorary membership in appreciation of his numerous contributions to cancer statistics research.

A dinner was given in New York on December 2 by the American Society of Mechanical Engineers in honor of Dr. Calvin W. Rice, secretary of the society for the past twenty-five years. Dr. Rice was made an honorary member of the society in recognition of his long and valuable services. The presentation was made by Dr. John R. Freeman, of Providence, and President Karl T. Compton, of the Massachusetts Institute of Technology, of which Dr. Rice is a graduate, delivered the address.

The University of Michigan has been presented with the bust of Dr. Cyrenus Garritt Darling, professor emeritus of oral surgery, who for thirty-seven years was connected with the School of Medicine and Surgery and the College of Dental Surgery. The ceremony was held at his home, the presentation being made by Dr. Frederick Novy, professor of bacteriology, who spoke for the donors. The bust was accepted for the university by President Alexander Grant Ruthven, who spoke of the services that Dr. Darling had rendered to his school, to his state and to humanity. The bust is the work of Mr. Carleton W. Angell, artist in the university museums and instructor in modeling in the College of Architecture.

Dr. Byron H. Jackson, of Moses Taylor Hospital, Scranton, Pennsylvania, was elected president for 1932 at the recent congress at St. Louis of the Radiological Society of North America. He succeeds Dr. Francis Carter Wood, of Columbia University.

At a recent meeting of the New York Academy of Medicine, Dr. John A. Hartwell, president of the academy, was re-elected for a second term of two years. Dr. Lewis A. Connor, second vice-president, will automatically become first vice-president at the beginning of the new year. Dr. Frederick Tilney, professor of neurology in the College of Physicians and Surgeons of Columbia University, was elected second vice-president to fill the term of Dr. John O. Polak, who died last summer. Dr. Harlow Brooks was elected third vice-president to succeed Dr. Edwin Beer.

Professor A. C. Dixon has been elected president of the London Mathematical Society. The vice-presidents are Professor S. Chapman, Professor H. Levy and Mr. T. L. Wren.

Nature reports that the following officers have been elected for the Cambridge Philosophical Society: *President*, Professor A. Hutchinson, *Vice-presidents*, Mr. G. Udny Yule, Dr. W. H. Mills, Mr. F. T. Brookes; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Dr. J. D. Cockcroft, Dr. H. Hamshaw Thomas, *New Members of the Council*, Dr. R. H. Rastall, Mr. C. F. A. Pantin, Mr. N. F. Mott.

Dr. Esmond R. Long, professor of pathology at the Graduate School of Medicine of the Division of Biological Sciences of the University of Chicago, has resigned to become director of laboratories of the Phipps Institute of the University of Pennsylvania, his resignation to become effective in July, 1932

DR. EWEN M MACEWEN, professor of anatomy at the University of Iowa College of Medicine, has been appointed head of the department to succeed the late Dr Henry J Prentiss.

THE *Experiment Station Record* reports that Dr Frank T Shutt has retired as Dominion chemist and assistant director of experimental farms of the Canadian Department of Agriculture, thereby terminating a public service of forty-four years Mr L E Kirk, professor of field husbandry at the University of Saskatchewan since 1922, has been appointed Dominion agrostologist at the Central Experimental Farm, Ottawa Dr Allen Deacon has been appointed Dominion animal geneticist

THE Macbeth-Evans Glass Company, Charleroi, Pennsylvania, has established in the Mellon Institute at Pittsburgh a fellowship in illuminating glassware to which Dr Rob Roy McGregor, of the Mellon Institute research staff, a specialist in physical chemistry, has been appointed

M EMILE PICARD, permanent secretary of the Paris Academy of Sciences, has been elected a member of the French Council of Public Instruction

DR ALFRED STENGEL, vice-president of the University of Pennsylvania, in charge of the medical group, has been elected a member of the board of managers of the Wistar Institute to fill the vacancy caused by the death of Mr Arthur L. Church

DR. WILLIAM D CUTTER has been appointed secretary of the Council on Medical Education and Hospitals of the American Medical Association.

DR ORLANDO H PETTY has been appointed health officer of Philadelphia following the death of Dr Andrew A Cairns in September

DR. W F FOSHAG, curator of mineralogy in the U S National Museum, has returned from field-work in Mexico, where he visited mines and studied the mineral deposits in the states of Zacatecas and San Luis Potosi

DR. F VENING MEINESZ, of the Dutch Geodetic Commission, an expert on the measurement of gravity at sea, is coming to the United States to take part in the International Expedition to the West Indies, sponsored by Princeton University. Dr. Meinesz will attend the meeting of the Geological Society of America at Tulsa where he will give a paper on "Gravimetric Studies in the East Indies and Folded Mountains."

DR. MAJOR GREENWOOD, professor of epidemiology and vital statistics at the London University School of Hygiene and Tropical Medicine, is giving three Herter Foundation lectures at the Johns Hopkins University School of Medicine. Dr Greenwood was the guest of honor at a dinner of the medical faculty at the Maryland Club on December 3.

ADMIRAL CARY T GRAYSON, M D., an alumnus of the Medical College of Virginia, Richmond, delivered its founder's day address on Tuesday, December 1. This marks the ninety-fourth session of the institution. His subject was "The Modern Trend of Medicine"

DR. C E K MEES, director of research and development for the Eastman Kodak Company, delivered the first of the annual series of Aldred Lectures at the Massachusetts Institute of Technology on December 4. The title of Dr Mees's address was "Reminiscences" At noon on the same day he addressed the Technology Faculty Club

DR. W H TALIAFERRO, professor of parasitology at the University of Chicago, will deliver the third Harvey Society Lecture at the New York Academy of Medicine on December 17 His subject will be "Infection and Resistance to the Blood Inhabiting Protozoa"

DR G CANBY ROBINSON, director of the New York Hospital-Cornell Medical College Association of New York City, delivered the History of Medicine Lecture at Vanderbilt University on December 3 His subject was "The Liberators in Medicine—Vesalius, Paré and Paracelsus"

THE HONORABLE BERTRAND RUSSELL was the speaker before a general convocation at the University of Oklahoma, Norman, on November 23. His subject was "The Scientific Outlook." He also spoke to the members of the staffs of the departments of philosophy and of the several natural sciences at a luncheon given under the auspices of the department of philosophy.

DR. OLIVER KAMM, director of research of Parke, Davis and Company, Detroit, was the principal speaker before the New York section of the American Chemical Society on the evening of December 4. He spoke on "Chemical Investigations in the Field of Ductless Glands."

AT the inaugural meeting on November 7 of the eighty-third session of the Royal Canadian Institute, Dr. E. F. Burton, professor of physics at the University of Toronto, delivered the presidential address, entitled "Seeing the Invisible." The lecture was in celebration of the Faraday-Maxwell Centenary.

THE biennial Huxley Lecture on recent advances in science in their relation to practical medicine was given at Charing Cross Hospital Medical School on November 26, by Sir Almroth Wright. His subject was "Immunity the Old Doctrine and the New "

At a recent meeting of the Royal College of Surgeons, London, the appointments were announced of Dr Robert Cruickshank, of the University of Glasgow, as Milroy Lecturer for 1933, and of Professor Edward Mellanby as Croonian Lecturer, 1933

The Oriental Institute on the campus of the University of Chicago, built at a cost of $1,500,000, which is the largest archeological headquarters in the world, was formally opened and dedicated on December 4. Dr James H. Breasted, as director of the institute, unlocked the gates of the five exhibition halls—those for the Egyptian, the Assyrian, the Assyro-Babylonian, the Persian-Moslem and the Hittite-Palestinian civilizations. The speakers, in addition to Dr Breasted, were Dr Raymond Fosdick, of the Rockefeller Foundation, and Dr John H Finley, associate editor of *The New York Times*

Ground was broken on November 9 for the Division of Plant Pathology at the Princeton branch of the Rockefeller Institute for Medical Research. The new buildings will consist of a laboratory, 144 feet by 40 feet, two and one-half stories in height, eight greenhouse units, each 65 feet in length, and a potting shed. Dr Louis O. Kunkel, of the Boyce Thompson Institute for Plant Research, will be in charge of the new division. The buildings were designed by Messrs. Coolidge, Shepley, Bulfinch and Abbott, of Boston, and are being constructed by Matthews Construction Company, of Princeton, New Jersey. The name of the Princeton branch has been changed to the Department of Animal and Plant Pathology of the Rockefeller Institute for Medical Research.

The house which John James Audubon built and in which his last years were spent is to be saved after having been abandoned to the wreckers, according to an announcement made by Harold W. Decker, an ornithologist of the Bronx The building, which stands now below the viaduct at Riverside Drive and 155th Street, New York City, hemmed in by tall apartment houses, is being removed in sections, to the new park site provided by the city at Riverside Drive and 161st Street. There it will be restored to the condition it was in when Audubon entertained his friends, in his home away from "the crazy city," far to the south. The removal expenses have been underwritten anonymously and a fund of about $25,000 will be needed to complete the work of restoration. The National Association of Audubon Societies, 1974 Broadway, New York, N Y, will receive contributions.

According to the *British Medical Journal* Lord Moynihan, president of the Royal College of Surgeons of England, laid the corner-stone of the Wellcome Research Institution on November 25. This is the new building now in course of erection in Euston Road and Gordon Street, W.C, London When completed the institution will embrace the following affiliated laboratories and museums bureau of scientific research, physiological research laboratories, chemical research laboratories, historical medical museum and museum of medical science. The architect's design for the building was exhibited at the Royal Academy last summer

Director Barton Warren Evermann, of the California Academy of Sciences, announces that on December 3 the power cruiser *Valero III*, owned by G. Allan Hancock, left San Pedro, California, under the auspices of the academy, bound for Central and South American waters The primary object of the expedition is the study and collection of marine life, especially fishes, from those tropical seas. Provision has been made for the use of dredges, trawls, traps and other forms of collecting equipment, some of which is newly designed for special purposes The program calls for stops at Mazatlan, Acapulco, Panama, Cocos Island, Malpelo Island and the Galapagos At the last place special attention will be given to stocking the eight tanks being carried, with live fishes for display in the Steinhart Aquarium of the California Academy of Sciences in San Francisco Mr Alvin Seale, superintendent of the aquarium, is in immediate charge of the scientific work, assisted by Dr. L. G. Hertlein, who will make general collections, particularly of mollusca and fossils. Collections of living reptiles, birds and marine mammals will be obtained for the San Diego Zoological Park, this phase of the work being under the special charge of Mr. Charles B Perkins, of Denver, Colorado.

The *Journal* of the American Medical Association writes under "Current Comment" as follows. "Repudiation of the Bilbo administration, which so nearly wrecked the educational institutions of Mississippi, occurred recently when Martin Sennett Conner was overwhelmingly elected governor. The standing of the medical school of the university was threatened in 1930 when the dean and the entire faculty were ousted and others put in their places A partial restitution took place when the Council on Medical Education and Hospitals of the American Medical Association, the Association of American Medical Colleges, and other organizations interested in higher education, the united medical profession of Mississippi and an aroused public opinion protested against such high-handed and destructive tactics. Most of the faculty members were recalled and Dr. P. L. Mull, professor of anatomy, was named acting dean. Professors were graciously lent to the school by Vanderbilt University and the University of Tennessee The medical school was nursed along through this trying period, but it is now evident that the people of the state of Mississippi were eagerly awaiting the time when they could administer a death blow to further officious interference with their schools The new governor will no doubt be constructive rather than destructive in educational matters"

The London *Times* reports that an extension to the research laboratories of the English Steel Corporation, Limited, at Vickers works, Sheffield, was opened on November 8 by Sir Joseph Thomson, master of Trinity College, Cambridge He described these new laboratories "as a signal token of the advance in importance attached to research by industry It was a comparatively recent thing for research and industry to be linked together Not long ago the bulk of the people in industry took the view that things might be 'all right,' but would not work in practice, and in those days science and industry were rivals, well aware of each other's imperfections. He did not suggest that all the fault was on the side of the manufacturers, for often men of science did not realize the immense amount of work which had to be done to take a discovery from the shelter of the laboratory into the rough-and-tumble of the works The transition often required years of work and cost much Between the laboratory and the works was a long stretch of country through which it was difficult to find a way, but when the way had been found the reward was very rich To the people engaged in the laboratories he particularly emphasized the importance of looking for the unexpected, for it was from the unexpected discovery that new industries were formed and new employment created"

The department of zoology and physiology of Wellesley College, housed in temporary quarters since 1914, when College Hall was destroyed by fire, now occupies a new building The erection of the zoology unit completes Sage Hall, the botany wing of which was opened in 1927 The building, modern in construction and equipment, includes laboratories for the introductory course and for more advanced courses in zoology and physiology, lecture rooms, small private laboratories for the staff, department offices, adequate storage space Among the features of special interest which contribute to the convenience and teaching value of the new building the following may be mentioned: room for giving new courses long postponed, a departmental library, a memorial to Miss Caroline B Thompson, a former member of the department; a demonstration room for the exhibition of illustrative material for the elementary course, a museum for the display of collections long kept in storage, a small greenhouse; a vivarium including mammal rooms with out-of-door runs, turtle pools, and frog tanks, fresh and salt water aquaria, Daphnia tanks Mr Kitson, of the State Fish Commission, has given to the department between three and four hundred fresh water fishes including pickerel, sun fish, speckled trout and pout As soon as the salt water has been installed Mr O'Brien, of the South Boston Aquarium, has promised the department salt water forms A tame skunk, the gift of Benson's Animal Farm, Hudson, N H, occupies one of the mammal rooms, a well-arranged monkey room still awaits an occupant The vivarium not only serves as quarters for guinea pigs and rats used in dietary experiments, etc, but it will, it is hoped, stimulate in students and staff an interest in the natural history side of biology

It is planned to erect for the Forest Products Laboratory of the University of Wisconsin, at a cost of $900,000, a building to provide facilities for every known technical test of wood in all stages of its transformation from logs to paper and turpentine. The building, which will be U-shaped, about 275 feet long and for which ground already has been broken, will be six stories high, with 175,000 square feet of floor space It will stand on a ten-acre site overlooking Lake Mendota at Madison It is hoped that the building will be completed in August, 1932 Six floors at one end of the building will be used as pulp and paper research laboratories Provision is made for a large timber preservation laboratory, a wood fermentation unit, fractionating stills, a general section of wood chemistry, wood glueing, painting, finishing and fireproofing laboratories, and facilities for the study of wood fungi and insect pests A railroad siding, a power plant of 630 boiler horsepower, and a number of service elevators, hoists and monorails will be required The laboratory was established in 1910 and has occupied buildings owned by the University of Wisconsin The work has been carried on for several years by a staff of two hundred members and the laboratory has outgrown its present quarters. The state appropriation has recently been doubled. The land on which the new building will stand was given by the regents of the University of Wisconsin

According to the *Experiment Station Record* the Minnesota State Legislature has made provision for increased facilities for both field crop and horticultural plant breeding investigations in the Agricultural Experiment Station of the University of Minnesota. An appropriation of $30,000 was made for the erection and equipment of a farm crops field house at University Farm This will be used for the curing and storing of nursery and increase stocks and will contain weighing, drying and preparation rooms and facilities for cleaning and storing seed stocks of various kinds For the fruit farm near Zumbra Heights in the Lake Minnetonka district, $9,000 was appropriated for the purchase of additional land and $13,500 for an office building and laboratory Nearly all the investigations in fruit crop breeding are conducted at this farm, and the laboratory will provide much-needed facilities and greatly expedite the making of records and the interpretation of results.

DISCUSSION

CYCLONE AND ANTI-CYCLONE

IN some recent letters, published[1] and personal, Sir Napier Shaw suggests that we might with profit employ the terms *"air-sink"* and *"air dump"* for cyclone and anticyclone Both of the last-named have done honorable service, and it will be long before they are eradicated from conventional usage in all treatises on airgraphics But even as we are eliminating the almost unpronounceable word meteorology, so we may gradually dispense with terms that have outlived their usefulness Cyclone came to us from Piddington, with the Greek κυκλος or coil of a snake, and anti-cyclone from Francis Galton, as the opposite of an uprising, rotary wind structure It would now seem that we have unconsciously overstressed the importance of the circulatory air flow in a depression or cyclone, and so neglected the scooping-out or removal of air on the one hand and the heaping-up or cumulative effect on the other, which is so aptly pictured as a *dump* This overstressing of the "low" as shown by the surface air flow and a positive insistence upon the fundamental physical relation that air flow is initiated by pressure, and pressure only, has resulted in missing a most important factor in the formation of areas of high and low pressure

To quote Sir Napier Shaw

> So pressure-gradient comes to be the mere index of the response of an air current to the centrifugal force of the earth's rotation aided or counteracted by any local curvature of the air's path.

Here then we come to a new point of view, as explaining the origin, also maintenance, of highs and lows, and this is of importance in forecasting the weather, and an understanding of the daily maps Cyclone and anticyclone are really created and maintained by the winds of the straight isobars that lie between them. To quote further from Sir Napier

> The high and the low are mere incidents of the relative motion of the air currents of different directions In the northern hemisphere wherever the passing currents keep the English rule of the road, with opposing traffic on the right, high pressure (and generally fine weather) between them is the inevitable consequence, but wherever the atmosphere adopts the continental rule of keeping the opposing traffic on the left, there a "low" between them is equally inevitable

This fundamental law in forecasting we have recognized for some years at Blue Hill Observatory, and may be expressed briefly as, "An air flow from northwest, north or northeast, in advance of a flow of warm, moist air from south or southwest, is less likely to give precipitation and form a depression than when the southerly air flow is in advance of a dry, cold flow from the north" In keeping with the new point of view, we should perhaps mark storm paths, not from the loci of minimum pressure but from the points of wind conflict.

Much more could be said concerning an automatic balance between wind velocity and gradient under the influence of the earth's rotation, but it must suffice for the present to call attention to this shifting of attention from pressure minima to air-flow effects as the really important dynamical agents

Sir Napier has also calculated the energy of the horizontal motion of a 100 meter layer of air, in thickness, with pressure interval of 2 kilobars as approximately 26,000 kilowatt-hours, varying with height and latitude

ALEXANDER MCADIE

HAMPTON, VA.

THE UNCERTAINTY PRINCIPLE

IN his note on "The Uncertainty Principle and Free Will" published in SCIENCE for August 14 (p 172), Professor A H Compton seems to overlook the important distinction between a thing which is *indeterminable* and one which is *indeterminate.* No one can predict with accuracy and certainty what the weather will be to-morrow, to say nothing of predicting what it will be a week or a month hence. But I think no scientific man would claim that because the weather is indeterminable it is indeterminate—that the weather to-morrow will not depend, inevitably, on conditions which exist to-day

It may be an "even chance" whether the photon of which Professor Compton writes will enter one or the other of two photoelectric cells, but it is illogical to suppose, for that reason, that the conduct of the photon is not determined by complex conditions of such a character that prediction is impossible. The fact that so minute an event may produce tremendous results has no connection with the question whether the event is determinate or not.

---

[1] *Nature,* June 27, 1931, "Potential Temperature and the Stratosphere"; August 8, 1931, "The Energy of Horizontal Atmospheric Motion."

Darwin may be right when he says that the problem of "free will" "is a philosophic one outside the thought of physics," but such a statement depends on one's definition of physics and of science. It is true if we include in science only those things which are fully known and can be mathematically demonstrated In an article by Professor Evan Thomas on p 173 of the same number of SCIENCE several beautiful illustrations are given of important advances in science which began, not with rigid mathematical reasoning or logical conclusions from a set of observations, but by a quite different process. Such advances must always be submitted, afterwards, to the test of agreement with observation, and, if possible, to mathematical treatment. Science would be a very poor affair if it rigidly excluded all ideas for which this process is incomplete—indeed, is it possible to say of any fundamental idea that the process is complete? Science and philosophy, in their higher reaches, should be identical.

W A. NOYES

UNIVERSITY OF ILLINOIS

THE UNCERTAINTY PRINCIPLE AND FREE WILL

A RECENT number of SCIENCE[1] contains an extremely interesting article by Professor A H Compton, showing the possible effect of Heisenberg's uncertainty principle upon macroscopic phenomena It illustrates beautifully a point which has been frequently overlooked, namely that, in certain instances, uncertainty is cumulative and creeps into large scale events.

There has been considerable speculation as to the possible significance of this fact relative to the problem of free will The present note endeavors to clarify the relation between these two issues and to show, incidentally, that no connection between them exists.

We desire mainly to point out two things·

(1) In Compton's example, uncertainty governs the fate of the photon. The response of the amplifying device appears dependent upon the photon's fate. The amplifying action is causal in the direct, acausal in the indirect sense. "Freedom of choice" in the amplifying device would involve its capability of guiding or affecting the photon's fate, a postulational element which is metaphysical and proves to be unreasonable upon closer inspection.

Any attempt to establish the possibility of free will on the basis of physical uncertainty has also a formal flaw from the point of view of the all-embraciveness of quantum theory The uncertainty principle has transformed the causally closed into a causally open world. Hence a proposal to reverse this transformation would appear inconsistent with recent developments in theoretical physics. It is to be noted that the establishment of free will is such an attempt of filling the causal gap by supplying the lacking determinant in form of the individual's decision, and is therefore contrary, in one sense at least, to the spirit of quantum dynamics It must be admitted, however, that this last consideration is stringent only for those who refuse to supplement the physical world by extraphysical elements

(2) The second and major point of this note regards the problem of freedom of will itself This philosophical problem arose in connection with that of individual moral responsibility and has to do with the determining factors of human motivation. It belongs to a domain which is intrinsically foreign to physical lawfulness and must be distinguished clearly from the somewhat less problematical question of freedom of action Philosophers have usually observed the demarcation (*actus elicitus voluntatis vs. actus imperatus voluntatis*) Compton's argument demonstrates a possibility for freedom of action—though a very limited one—this action being the release of one of a number of physically indeterminate sequences of events, which occurs after the volition has been formed But it does not touch the problem of the motivation of this volition. Hence there is no intelligible connection between quantum-mechanical uncertainty and free will.

HENRY MARGENAU

YALE UNIVERSITY

THE CLASSIFICATION OF PYTHIUM[1]

SPARROW has presented in SCIENCE 73. 41–42, a point of view on the classification of members of the genera Nematosporangium and Pythium which, although correct in certain respects, is misleading in certain others. He has argued that the genus Nematosporangium be dropped and its members included in Pythium, that certain of the organisms now placed in Pythium be transferred to Sphaerosporangium and that the members of the genus Pythium with lobulate prosporangia be placed in the genus Rheosporangium.

Sparrow is correct in his first assertion in dropping Nematosporangium and placing its organisms in Pythium, as far as priority is concerned. It is true that the original type species of Pythium was *P. monospermum* Pring,[2] which is now included in Nematosporangium. This species, however, is very rare and the genus Pythium became more known and typified by the later discovered *P. proliferum* de Bary[3] and *P. debaryanum* Hess,[4] because of their wider distribution and greater economic importance. Both *P proliferum* and *P debaryanum* differ from *P. monospermum* to such an extent as to justify the creation of two genera. Fischer[5] created at a later date the subgenera Nematosporangium and Sphaerosporangium and placed *P monospermum* in the former subgenus and *P debaryanum* and *P proliferum* in the latter Schröter[6] in 1897 elevated Nematosporangium to generic rank and placed all the organisms then in the subgenus Sphaerosporangium in Pythium This scheme of classification has been approved by Lindau[7] and recommended by Fitzpatrick[8] and, in the opinion of the writer, it is practical and divorced from complications and ambiguity

---

[1] "The Uncertainty Principle and Free Will," SCIENCE, 74: 172, August 14, 1931.

[1] Published with the approval of the Director as Miscellaneous Paper No. 11 of the Experiment Station of the Association of Hawaiian Pineapple Canners, University of Hawaii.

[2] *Jahr. Wiss. Bot.*, I, p. 288, 1858.

Pythium debaryanum came to be known as the type species of the genus in the pathological literature, because of its constant association with seedling root rot Very few plant pathologists and even mycologists have ever seen *P monospermum* but nearly all have had some practical experience with *P debaryanum*. It is through such an experience that the morphology of practically all pythiaceous organisms has been compared with that of *P debaryanum* One will readily see the fallacy and injustice of placing members of the genus Nematosporangium under Pythium especially in the case of *Rheosporangium aphanidermatum* Edson.[9] *R. aphanidermatum* does not vary any more from *Pythium monospermum* than does *P. proliferum* from *P debaryanum* It is, therefore, as true a member of the genus Pythium as the type species *P. monospermum*. Yet, in spite of all this evidence, Edson created the new genus Rheosporangium to find a place for his organism! The writer believes that the fault is not with the investigator, but with the taxonomic system because it has failed to differentiate properly between completely distinct organisms.

Sparrow recommends the reestablishment of the genus Rheosporangium to include all those members of Pythium with lobulate prosporangia. It is very unfortunate that Sparrow did not read very carefully the description of *P. monospermum*, or else he would have noticed that the hyphae of this organism possess bud-like outgrowths which came to be known by later investigators as prosporangia. The German text in connection with the lobulate prosporangia of *P. monospermum* reads as follows: ". . . Fäden oft mit vielen Kurzen annähernd rechtwinkelig ansetzenden Seitenästen. . "

My answer to Sparrow's criticism of my paper[10] for the non-segregation of members of Nematosporangium with filamentous prosporangia from those with lobulate ones is that I have never seen any species of Nematosporangium (*Pythium monospermum* type of organisms) lacking the lobulate prosporangia (bud-like outgrowths of Butler or plasmatoogoses of the writer[11] These bodies vary in size and number in different species, but they are present, nevertheless, in all species. With species which reproduce sexually very readily and abundantly the lobulate prosporangia are not very numerous, and *vice versa*

If the recommendations as proposed by Sparrow are accepted there is a danger of leaving the genus Pythium without any members If all of the species with lobulate prosporangia including *P monospermum* are placed in Rheosporangium and those with spherical prosporangia including *P. debaryanum* in Sphaerosporangium, then there will not be left any more members for Pythium

C P. SIDERIS

EXPERIMENT STATION A H P C,
UNIVERSITY OF HAWAII

"TASTE DEFICIENCY" FOR CREATINE

THE observation that to certain individuals *p*-ethoxy phenyl thiourea tastes bitter, while to others it is tasteless has led to Professor L H. Snyder's study of the inheritance of this taste deficiency as reported in SCIENCE for August 7, 1931.

A few years ago the writer, with Mr P. A. Lasselle,[1] noted a somewhat similar situation with regard to the familiar muscle constituent creatine. We had a sample of what eventually was proved to be this substance submitted to us for identification The melting point recorded in the literature was somewhat in error, but the properties of the substance suggested that it might be creatine.

Creatine, however, was described in the literature as bitter, whereas the substance in question seemed to both of us to be as tasteless as chalk. Further study convinced us, nevertheless, that it was actually creatine. It was not, I believe, until we had submitted it to the fifth person that we found one who reported a bitter taste.

The fact that even this familiar food constituent has these distinctive reactions on different individuals is perhaps a significant one. Since a pound of lean meat may contain nearly two grams of creatine it would be surprising if this taste difference did not manifest itself in giving meats distinctive flavors for different individuals Especially should this be so for soups made from lean meat which must contain a considerable quantity of extracted creatine Possibly the taste which creatine has for certain individuals is destroyed by the presence of other food constituents

---

[3] *Jahr. Wiss. Bot.*, II, p. 182, 1860

[4] *Dissert.* Halle, 1874

[5] Rabenhorst's "Kryptogamen Flora von Deutschland, Oesterreich und der Schweiz." IV *Abt. Leipzig.* 1892

[6] *Engler-Prantl.* "Natürliche pflanzenfamilien. Pythiaceae, 104–105, 1897.

[7] "Die mikroskopischen pilze," Berlin, 1922

[8] *Mycologia*, 15: 166–178, 1923.

[9] *Jour. Agr. Res.*, IV: 279–291, 1915.

[10] SCIENCE, 71: 323–324, 1930.

[11] *Mycologia*, 23: No. 4, 1931.

[1] *Jour. Am. Chem. Soc.*, 48, 536, 1926.

The problem is associated with the more general one of individual metabolic idiosyncrasies, which calls for extensive study It is a fact which is not always recognized in medical practice that occasional individuals react in quite a distinctive way toward particular drugs, among which are such familiar ones as morphine and novocaine. A man of my acquaintance who has a normal sense of smell in other respects is unable to detect the odor of skunk Even a sample of n-butyl mercaptan, which is the perfume carried by these animals, had no unpleasant odor for him.

ROGER J WILLIAMS
UNIVERSITY OF OREGON

SCIENTIFIC BOOKS

The History and Work of Harvard Observatory, 1839–1927 By SOLON I BAILEY New York and London, McGraw-Hill Book Company, Inc, 1931 (Harvard Observatory Monographs, no 4)

SELDOM, if ever, has a subject concerned with the history of science received as interesting a treatment as in the book under review The volume "The History and Work of the Harvard Observatory, 1839–1927" is the fourth of the well-known monographic series issued by this observatory It is from the pen of the late Dr. Solon I Bailey, who was Phillips professor of astronomy, emeritus, at Harvard University, and one of the oldest and most distinguished members of the Harvard Observatory staff Dr Bailey's long connection with the practical research of the observatory made him intimately acquainted with every phase of the important work carried on there, and he was therefore well prepared to write a unique historical account as set forth in this book. It is indeed fortunate when one who reaches the honored title emeritus can give his time to introspection and reflection upon the accomplishments of his period and of his institution. Harvard College Observatory ranks as the oldest research observatory in the United States, and it is therefore peculiarly fitting that a historical review should be placed before scholars This observatory may be said to have found its roots deep in our early Colonial period—for astronomy seems to have been taught and "practiced" almost from the date of the founding of this Puritan college in 1636

The summary of the vast contributions of the observatory is written in Dr Bailey's simple and characteristic narrative form, which is not lacking in vividness and humor and is so presented as to be of service to both the layman and the professional scholar The book is composed of three large divisions, in logical sequence, with a total of twenty-one chapters The first part gives briefly the historical outline of the ancestry of the observatory, showing how the pioneer efforts in organizing research in astronomy were developed, and an account of the first astronomical expedition in this country by Harvard College to observe the transit of Venus in 1761 There is also given a short life sketch of the first Colonial astronomer, John Winthrop (1714–1779) Unfortunately this chapter contains several minor errors in historical facts and dates Thomas and William Brattle were brothers and not father and son Both were prominent scholars, Thomas Brattle furnishing observations on the Comet of 1681 which were highly important to Halley and Newton in developing the first calculations of the orbit of a comet William Brattle was the first tutor in philosophy at Harvard College Dr Bailey calls attention to the great influence exerted upon science by John Quincy Adams, the sixth President of the United States, who was the godfather of three observatories in the United States, which were called by his critics the "lighthouses of the sky" The chapter continues with a description of the temporary quarters of the observatory, known as the Dana House, which housed the few instruments in possession of the first director, William Cranch Bond The present observatory owes its origin to the public interest shown at the appearance of the Comet of 1843. A complete account is given of the gradual enlargement of the instrument equipment and the notable number of expeditions to observe solar eclipses and to determine the location of new sites for auxiliary observatories. The final chapter of this historical part treats of the various publications of the observatory which afford to students of practical and theoretical astronomy unlimited resources for further researches

Part two, which is devoted to scientific problems, is practically a complete study of the contents of the publications known as the Annals, Bulletins, Monographs, Reports and Circulars. It also reveals the pioneer character of many of the problems undertaken by this observatory, of which, of course, the most interesting is the account of the adoption of photography in the study of celestial phenomena. The difficulty with the so-called "collodian wet-plates" and the daguerrotype process was finally overcome by the dry, high-speed plates, and to-day the main reliance for advances in practical research is on photographic processes. No observatory to-day contains such a wealth of valuable photographic plates as the Harvard Observatory collection. The invention of this photographic process made possible the first systematic study of stellar spectra, photometry and charts of the standard regions of the sky. The Henry Draper Catalogue of the classification of the spectra is one of the great contributions of this observatory. The later period of the research work of the observatory is centered upon the problem of cosmogony, the study of variable stars, novae, clusters, nebulae and the Magellanic clouds. A survey of the wealth of analytic material here set forth is beyond the limits of this review, suffice it to say, no reader can afford to overlook part two if he wishes to understand the fundamental problems in astronomy and the methods of approach. Dr. Bailey's ability to synthesize the whole of Harvard's contributions to astronomy is abundantly demonstrated here.

The third division of this book is devoted to biographical sketches of the principal members of the staff, beginning with the Bonds (father and son) and ending with the benefactors of the observatory. Dr. Bailey has written of the lives of the first four directors with sympathetic feeling and appreciative understanding of their struggles and labors, and pays tribute to their sturdy New England characters and philosophy coupled with perseverance, purposiveness and idealism. It is interesting to note in passing that William C. Bond installed the first large refractor (15 inch) in this country, and he also made the first electric chronograph. Bond was the first American associate of the Royal Astronomical Society of London. George P. Bond, the second director, was better trained for his duties than his father, having graduated from Harvard College. He was also the first to make systematic observations and critical studies of nebulae. His studies of the Orion nebulae and Donati's comet will probably remain as classics for many years, and as he was mathematically inclined, he carried his researches much further than his father, He was a pioneer in celestial photography, and the sum total of his astronomical contributions brought him the first Gold Medal awarded to an American by the Royal Astronomical Society of London, 1865. Joseph Winlock was the third director, and, like his predecessor, his term was of short duration. His directorship was known as the period of transition, as it carried the observatory out of its pioneer days and over to the modern period which began with E. C. Pickering in 1877. No comment is necessary upon the work of Pickering, as it is well known to contemporary astronomers. The statement that Pickering was the first president of the American Astronomical Society is incorrect and should be corrected in subsequent editions. This honor fell to Simon Newcomb, who presided from the first to the seventh meeting of this society, 1899 to 1905. Pickering was elected in December, 1905, immediately after the New York meeting. This error may have occurred in noting the contents of the title page of Volume 1 of the Publications of the American Astronomical and Astrophysical Society, which is misleading. The number of leading American astronomers, as well as foreign associates, who participated in the work at the observatory, either as graduate students or independently, is notably large. Among the American names that stand out are Asaph Hall, C. W. Tuttle, Truman Stafford, Arthur Searle, S. P. Langley, C. S. Peirce, W. A. Rogers, W. Upton, O. C. Wendell, Seth Chandler, A. L. Rotch, Joel Metcalf and Edward S. King.

Under Pickering's administration it is interesting to note that a large number of women were employed in actual research, and some have made considerable advances in their particular fields, among them being Mrs. W. A. Fleming, Dr. Annie Cannon, Miss H. S. Leavitt, Miss Antonia C. Maury and perhaps a dozen others. Pickering had also a remarkable faculty for interesting younger men and women in research work, and this interest has expressed itself in the formation of a society composed of amateurs for the study of variable stars, known as the American Association of Variable Star Observers.

Following the death of Pickering in 1919, Dr. Bailey served as acting director until 1921, when Dr. Harlow Shapley was elected to guide the future of Harvard Observatory. Shapley's work is too extensive and well known to compress within the limits of this review.

The book contains a double index, one for names and another for subjects, which, together with an extensive list of footnotes, makes it a book easy of reference. The illustrations for the most part are good, the type pleasing, and the paper is such that the book will stand use for years to come.

In this book Dr. Bailey has left a wonderful tribute to the observatory he served so long, and makes too inconspicuous the part he took in the study of practical and theoretical astronomy. The compactness of the study of the accomplishments of the observatory is highly commendable, and great credit is due the author for placing such a volume in the hands of historians. It is particularly recommended to all directors of observatories contemplating a similar volume for their own anniversaries.

Frederick E. Brasch

Library of Congress

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR THE STUDY OF CHROMOSOMES IN ENTIRE INSECT EGGS

In view of the numerous difficulties attending the study of chromosomes in insect eggs it is believed that the method outlined below may prove of value to other workers in the field, as it has to us Its essential feature is the use of the recently developed Feulgen test for thymonucleic acid[1] by means of which chromatin alone may be stained, leaving the other components of the cell almost transparent. Applying this method to the entire egg it is possible, in suitable material, to reveal the chromosomes distinctly without staining the yolk or other egg constituents, with the result that the maturation and cleavage divisions may be studied with ease

Not only does this method eliminate the laborious processes of embedding, sectioning and examining deeply stained serial sections, but it adds greatly to the reliability of the observations and also greatly extends the usefulness of each good preparation Reliability is enhanced by the fact that in the entire egg, thus prepared, no mechanical disturbance of parts has occurred and the inter-relations of the components (polar bodies, egg nucleus, sperm, etc) are obvious It is not necessary to reconstruct as with sections Usefulness of the individual preparation is increased by the fact that all the mitotic figures are intact, and both usefulness and reliability are increased by the fact that the egg may be moved about (rotated) in such a way as to permit bringing each figure into the most favorable position for study, and to permit examination of individual figures in different aspects (side view, polar view, etc)

We have used the method only on the eggs of one species—the fungus gnat *Sciara coprophila* Lint. The eggs of this fly are approximately 0.2 mm in length and 0 1 mm in thickness.

In such eggs it is possible to examine the chromosomes in any part of the egg with a 2 mm oil immersion objective and in most cases with a 1 5 mm objective. From our experience it seems probable that the method could be used satisfactorily even with considerably larger eggs for a study of the maturation divisions and of such cleavage divisions as occurred near the periphery of the egg, because of the possibility of rolling the egg about until the desired part becomes uppermost In the case of eggs with opaque or too resistant outer membranes such membranes would, of course, have to be removed mechanically, or punctured, as the case required

The procedure we have followed is given below: At suitable intervals after the eggs are laid they are fixed in a modification of Carnoy's solution (equal parts chloroform, absolute alcohol and glacial acetic acid) for from one half hour to two hours, and washed in several changes of absolute alcohol over a period of at least two hours Then they are passed through the higher alcohols, 95 per cent., 85 per cent, 70 per cent (one hour each), the lower alcohols, 50 per cent, 30 per cent, 15 per cent (one half hour each) and tap water (several changes) in preparation for the Feulgen treatment. For our material the stain is most successfully obtained in the following manner.

(1) Place eggs for 15 minutes in cold normal HCl solution, (2) transfer for 8–10 minutes to a similar HCl solution heated to 60° C, (3) rinse in cold HCl solution, (4) place for 2–5 minutes in SO_2 water, (5) stain 1 hour in fuchsin sulfuric acid solution, (6) wash in two changes (fifteen minutes each) of the SO_2 water, (7) rinse in several changes of tap water. The HCl and SO_2 solutions must be fresh, and the fuchsin sulfuric acid solution an amber color without red precipitate The formulae for the solutions and additional precautions as to their use may be found in Lee (*loc cit*).

The method requires some experience. Unless properly treated the chromosomes are apt to be pink or pale red, but in suitable preparations they are deep red in color, not unlike the color produced by safranin The color is relatively permanent.

After staining, the eggs are dehydrated rapidly in alcohol (not more than 5 minutes in each change up to 85 per cent), cleared in xylol and mounted in balsam in the usual manner on slides or between coverslips. If they are to be moved about and examined in different positions it is best to do the manipulating soon after mounting, although in our experience the balsam may readily be softened around the coverslip with xylol at any time within a few weeks after mounting. A green light filter aids materially in studying the figures.

In rolling the eggs during observation we have used the simple expedient of moving the coverslip to and fro. This usually suffices to turn the eggs. If more accurately controlled manipulation were desired the procedure could be modified as required—*e.g.*, the eggs could be examined in immersion oil without the use of a coverslip. When a coverslip is used it is necessary, of course, to adjust the amount of balsam to the size of the eggs in order to have as little as possible between the egg and the glass and at the same time to avoid flattening the egg by pressure of the coverslip. In practice this presents little difficulty

---

[1] Lee, "Microtomist's Vade-mecum," 9th edition, pp. 437–438 and footnote, p. 438

The fixative noted above is used simply because it appears to give the best fixation in our material Others may be substituted if desired. Contrary to early reports the Feulgen method of staining appears to be applicable to material fixed in any of the ordinary fixatives. We have used it after Fleming, Gilson's mercuric nitric solution and Bouin, as well as Carnoy

As an aid in transferring the eggs during dehydration, staining, etc, any of the standard methods of handling small objects may be used We use the method of packing them in Drosophila pupa skins when they are in 70 per cent alcohol after fixation[2] and then pushing them out of these cases either singly or in groups during the final process of mounting in balsam.

This investigation has been aided by a grant from the National Research Council, Committee for Research on Problems of Sex

M LOUISE SCHMUCK
C W. METZ
DEPARTMENT OF EMBRYOLOGY,
CARNEGIE INSTITUTION OF WASHINGTON

RECONSTRUCTION WORK BY THE USE OF CELLOPHANE

IN 1930–31 the writer began investigations on the development of the jugular lymph sacs in turtles In review of the literature on the vascular system, one observes that the only available extra-vitamin methods of studying the development of vascular elements, are by plastic reconstructions and by injections Excellent as these methods are in studying vascular anatomy, they merely show the extent of the system at any stage and many questions as to the exact way in which growth takes place can not be determined by them. For that reason a new method for studying the development of the system was being sought It seems hardly necessary to emphasize the advantage of using all possible methods in studying systems, if not always in one's own work, certainly through understanding the value of the observations of others and the necessity of comparing and testing the limitations of different methods

Material was being sought which was thin and transparent, so depth could be observed when used in reconstructions Cellophane answered the purpose, it being material of transparency, which is strong, durable and ,0017″ in thickness

Camera lucida drawings were made of serial sections on separate sheets of cellophane A projection microscope was used for the drawings, so that a relatively large field with a high magnification could be obtained This material made it possible to check each drawing carefully and quickly with the one preceding, before they were placed in reconstruction form It was found to be the best method to get every vascular element in the reconstruction and to establish, thereby, a graded series of stages of embryos of different ages, complete in all details, in which the vascular elements could be studied and compared in their proper relations. In some cases it seemed highly desirable to use different colored inks to represent the arteries, veins, lymphatics and nerves.

It seems to the writer that where wax reconstructions are necessary, the use of cellophane marks a decided advancement in the preliminary steps for making the plastic reconstructions The transparency of the material, making observation of depth possible, gives one an accurate course of the parts under observation in relation to other structures.

E R VAN DER JAGT
STATE UNIVERSITY OF IOWA

SPECIAL ARTICLES

SIMULTANEITY IN THE ONSET OF POLIOMYELITIS

THE observation has often been made that when multiple cases of poliomyelitis occur in a family or a similar group of children, the onset of symptoms in all the individuals affected is simultaneous or nearly so. Sometimes the first symptoms are weakness or paralysis of muscles; at other times the symptoms are indefinite and mild, with weakness or paralysis of muscles following only after several days, or not at all.

These occurrences point to a common and coincidental exposure to the virus of the group of children affected. From these children, secondary cases of the disease may arise in other children, according to circumstances varying from group to group. The secondary cases will be separated from the primary ones by an interval of one, two or even more weeks, which interval is called the "incubation period."

A corresponding simultaneity is shown in a remarkable manner by groups of monkeys (*Macacus rhesus* and *cynomolgus*) inoculated experimentally with a potent virus by simple nasal instillation. The incubation period in these animals is regular and accurate, it falls, in many of the tests, between the tenth and the fifteenth day following the first instillation, or between the seventh and the tenth day after the last instillation

---

[2] C. W Metz, "A Simple Method of Handling Small Objects in Making Microscopic Preparations." *Anat. Rec.*, Vol. 21, No. 4, pp. 373–374, 1921

The striking precision of the phenomenon may have an important bearing on the still discussed question of the mode of infection in epidemic poliomyelitis. No other means of producing the infection in monkeys gives a corresponding, regular result, and no other experimental method of inoculation, through an external portal, gives reliable results at all. The digestive organs in monkeys are impervious to the virus, or the virus penetrating the tract is destroyed quickly Not only is infection almost never produced by artificial feedings of virus, but monkeys which have resisted repeated artificial feedings are found to be as susceptible as normal or control animals to the nasal instillations

The regularity and simultaneity with which experimental infection can be induced by dropping the virus of poliomyelitis into the nares of monkeys, afford additional support for the view that the portal of entry of the virus in human beings is the upper respiratory mucous membrane

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
NEW YORK, N Y.

PRIMITIVE OR FILTERABLE FORMS OF BACTERIA

IN a previous note[1] we reported the general occurrence of filterable forms of bacteria in such substances as soils, hay infusions, decomposing manure, human feces and milk More recently, Sherman, Safford and Brueckner[2] have recorded a quantitative approach to this subject, which indicates that these primitive forms of bacteria are usually present in milk and milk products in greater numbers than are bacteria of familiar type.

The quantitative method in use in this laboratory was based on the assumption, later shown to be correct, that these primitive forms should occur in many substances in greater number than ordinary bacteria which are detected and enumerated by conventional methods. Serial dilutions of the substance under examination are made into glucose-beef infusion broth These dilution cultures, representing from 10^{-1} to 10^{-13} gram of the original material, are incubated one or two days at 37° C and then from two to three weeks at 30° C After incubation, the higher dilutions, which contain no growth of ordinary bacteria, are seeded on the surface of glucose-infusion agar plates The plates are incubated two days at 37° C. and, if necessary, longer at 30° C., after which they are examined for the delicate growth which Hadley has termed the "G" type colony Growth has been recorded as positive when on microscopic study, after further culturing if necessary, definite minute cells which would be recognized as "bacteria" were found

Aside from the quantitative approach, the most significant modification in this technique as compared with those previously used by Hauduroy,[3] Hadley, Delves and Klimek,[4] and others, is the longer incubation of the broth cultures This prolonged incubation in broth appears to be desirable in order to get definite growth on the first agar plates seeded therefrom

The numbers of primitive bacteria found by the application of this method are somewhat surprising. Nine samples of soil representing a wide range of productivity have yielded estimates ranging from 10^7 to 10^{12} per gram Other materials have shown Fresh human feces, two samples, 10^{12}, sour milk, two samples, 10^{11}, and raw market milk, six samples, 10^8 to 10^{12} per gram

While the occurrence of these primitive microorganisms in such large numbers may be difficult to believe in the light of previous knowledge of "bacterial counts," they are perhaps not unreasonable Ordinary bacteria are not infrequently found in numbers approaching and exceeding one billion per gram in certain types of decomposing and fermenting materials When probable relative sizes are considered, the presence of bacteria in the filterable stage in numbers approximating one trillion per gram appears plausible In this connection it is of interest to note that Clifton, Schultz and Gebhardt[5] have recently determined the size of the virus of poliomyelitis as probably less than "50 μμ in diameter"

With reference to the microscopically definite cells which are found in "G" type cultures, it should be remembered that workers in this field appear to be unanimous in the belief that these organisms represent a partially transformed state between the filterable (perhaps ultramicroscopic) and the non-filterable stages of the bacteria. Hadley, Delves and Klimek[4] have furnished rather definite evidence that this is in fact the case.

One of the most interesting points about the primitive forms of bacteria is their inertness on ordinary bacteriological media When these forms are cultivated in the laboratory until they appear microscopically as true bacteria, they still make only very meager growth on agar and do not cause the familiar changes in culture media which are characteristic of bacteria of ordinary type In other words, it appears that morphological reversion runs very much ahead of physiological transformation This has been noted by other workers It apparently was the case in the excellent work of Smith and Jordan[6] on the diphtheria organism Dr Hadley informs us (personal correspondence) that it has been true in all the work which he has done on this subject Kendall,[7] in his recent important contribution to this field of study, reports the same observation In their exceptionally complete work on the Shiga bacillus, Hadley, Delves and Klimek[4] succeeded in accomplishing a total physiological transformation of the organism through its various stages to the "adult" form of the laboratory culture with which the experiments were started In this connection we wish to report that some of our cultures which have been obtained from the filtrates of various substances, after several months' culture in the laboratory, ferment sugar broths and give physiological tests in other media simulating those obtained with ordinary bacteria

---

[1] SCIENCE, 73, 448, 1931

[2] *Proc Inter. Dairy Congress*, Copenhagen, July, 1931

[3] "Les ultravirus et les formes filtrantes des microbes," Paris, 1929

[4] *Jour Infect Diseases*, 48, 1, 1931.

[5] *Jour Bact.*, 22, 7, 1931

J M. Sherman,
C E Safford

Cornell University

DIAMAGNETISM IN METAL CRYSTALS

One of the fundamental problems in the study of the constitution of solid metals is to find the cause of the magnetic susceptibility due to crystalline state, which property is for most crystals very different from the atomic susceptibility of the metal As an example tin (Sn) may be mentioned, which is diamagnetic in the liquid state, paramagnetic in the "white" (tetragonal), and diamagnetic in the "gray" (hexagonal) modification Hence, one must conclude that the magnetic properties of a metal crystal depend mostly on an action caused by the coexistence of a number of molecules (atoms) in a given geometric configuration.

One fashion to approach this problem in a way which gives reliable measurements is the study of the magnetic susceptibility in anisotropic metal single crystals in different directions with regard to the crystal. After the magnetic constants of a pure crystal are known, a small number of atoms of another metal are added to the original substance, and a new single crystal of the same orientation is produced For most of the measurements bismuth (Bi) was used, since its crystalline susceptibility is 15 to 20 times larger than its atomic magnetism; it is, furthermore, one of the most diamagnetic substances known

The results obtained concerning the influence of foreign atoms on the magnetic properties of the crystal are the following.

(1) The presence of foreign atoms affects the magnetic properties of the crystal only if the atom goes into a solid solution Inclosures or occlusion of heterogeneous substances do not affect the susceptibility Thus, all metals which can not be dissolved in f i bismuth do not change its magnetic properties appreciably.

(2) If a soluble metal (Sn, Pb) is added in a quantity below the limit of saturation (which is very low—0 5 per cent to 3 per cent—for different enantiomorphous metals) the effect on the susceptibility is very large Beyond the saturation the effect due to enclosures of eutectic mixtures is negligible

(3) The effect of dissolved foreign atoms is surprisingly large and affects the crystal differently in different directions (An atomic concentration of 1 10,000 alone changes the susceptibility several per cent)

(4) The influence calculated per added atom within the solubility limits in the crystal depends on their number, i e, the first few atoms have an effect which may be 100 fold larger than the atomic effect for larger concentrations

(5) The dependence of the susceptibility of the crystal on the temperature is changed very much by foreign atoms such as to cause a large decrease with decreasing temperature The decrease is different in different directions.

The effect mentioned under (3) works in all cases investigated as to *increase* the anisotropy of the crystal, i e, the ratio of the susceptibilities normal and parallel to the axis becomes larger due to the fact that the diamagnetism parallel to the axis decreases This change is more distinct at lower temperatures, and it is thus possible *to obtain a crystal saturated with 3 per cent. Sn which is below 270° K paramagnetic parallel to the axis and diamagnetic normal to it.* Since the x-ray analysis of such crystals does not show any difference from the normal Bi-crystal, it is evident that the atomic complexes within the lattice responsible for the diamagnetism must be of much larger sizes than the wave-lengths of the x-rays used.

To account for the exceedingly small amount of foreign atoms sufficient to influence the crystal diamagnetism it seems necessary to accept one of the two alternative conclusions

(1) The distortion due to a foreign atom dissolved within the crystal lattice reaches very far (somewhat like 25 crystal-atoms in each direction.

(2) The foreign atoms are absorbed in discrete layers within the crystal, the total effect thus being due to an internal surface phenomenon.

The former assumption, of far-reaching influence in dissolved atoms, can not be reconciled with the fact that no change in the lattice parameter can be detected by x-rays. It also contradicts the observation that the atomic influence decreases with increasing concentration of foreign atoms.

---

[6] *Jour. Bact.*, 20, 25, 1930.

[7] Science, 74, 129 and 196, 1931

The latter conclusion seems to be more probable, since the formation of block-like complexes within a crystal produces large additional surfaces which absorb foreign atoms and thus form potential thresholds preventing the development of large free paths of electrons necessary for the crystal diamagnetism It is obvious that the amount of foreign atoms necessary to form absorbed layers is many times smaller than the amount necessary for any volume-distortion Furthermore, the change in internal surface conditions would scarcely be detectable by x-rays

The size of these complexes calculated from the influence of foreign atoms comes out to be of the order of 1 micron (10^{-4} cm) and is in good agreement with the size observed microscopically by Goetz and is also in qualitative agreement with the theory of Zwicky of the secondary structure of crystals

This picture of a crystal leads to certain predictions

(1) The crystal diamagnetism should decrease as soon as the size of the crystal is less than the size of a crystal complex (secondary unit). (It was observed recently, first by Vaidyanathan, that colloidal particles of diamagnetic metals show smaller susceptibilities below a size of 1 micron.)

(2) The crystal diamagnetism should be influenced by any other change of the internal surface in the crystal (The dependence of the diamagnetism of Cu on irreversible deformation was observed by Bitter, Lowance and Constant)

(3) The electric conductivity—depending as well on the electric "transparency" of the crystal—should be affected the same way as the crystal diamagnetism. This was found true by Honda and his collaborators for the average susceptibilities on polycrystalline material.

It seems that the experiments described allow an insight into the constitution of a solid metal from a new angle, they also tie the crystal diamagnetism—a hithertofore isolated phenomenon—on to known electric qualities

ALEXANDER GOETZ,
A B FOCKE
CALIFORNIA INSTITUTE OF TECHNOLOGY

THE NATIONAL ACADEMY OF SCIENCES. II

Certain factors determining the direction of growth of nerve fibers H S BURR (introduced by R. G. Harrison) A problem which has baffled students of the nervous system for many years is the determination of the factors which direct the growth of nerve cell processes and fix their termination We do not know why olfactory nerves always end in olfactory centers We do not know that motor neurones from the brain always end at the proper level of the spinal cord for the innervation of specific groups of muscles These have been generally assumed. If they are true we need to know what factors in the nervous system and its environment bring them about. Several years ago while studying a related problem an amazing result appeared in a number of experimental conditions Transplantation in Amblystoma of an additional olfactory organ adjacent to that of the host resulted in the outgrowth of an olfactory nerve from the transplant, which, instead of joining the olfactory nerve of the host, grew into the wall of the brain a considerable distance behind its normal termination. Not all olfactory fibers followed this course some did run with those of the host into the forebrain, some followed the branches of nearby nerves to the skin, still others wandered blindly in the environing mesenchyme. These latter conditions can be explained partially on the basis of known facts, but the problem in which a new connection is established with the brain is not so easily solved. It is of fundamental importance that an adequate answer be reached, for the inherent implications are far-reaching. In the experimental condition we have a specific nerve establishing a new, different, one might almost say wrong connection in the brain. If such a thing is possible under experimental conditions it implies that the factors which bring it about are fundamental to the organization of the nervous system. Further, it implies that in given conditions neurones, instead of having their connections established according to a fixed pattern determined by the genetic history of the individual and its interplay with environment, may make contacts that are different and new. If this be true, then environmental circumstances, if they are of the proper sort, may alter the pattern of organization of the nervous system and thus profoundly affect behavior. What, then, are the environmental changes that bring about this new pathway of growth in olfactory neurones? An analysis of 175 experiments shows that conditions are right for the new connection in 29 cases. Of these 17 occurred after operations at one particular stage of development (Harrison stage 32). Furthermore, though outgrowth of olfactory fibers does not begin until five days after the stage of operation, at that time the wall of the brain is full of mitotic figures confined, however, to the relatively restricted area to which the nerve fibers eventually reach. Rapid cell division has been shown to be an index of high metabolic activity and the latter to be the head of a physiological gradient. In all probability this gradient, acting through the medium of a bioelectric field, attracts the growing olfactory nerves. These reach the area and, as has been shown elsewhere, stimulate the contained cells to continued cell division An augmentation of the gradient must then follow with profound effects upon all neurones in the field. The results of the experiments here presented are by no means conclusive, but they give definite clues as to the direction of continued research At present all we can say is that our evidence suggests that areas of high metabolic activity are important elements in determining the organization of the nervous system. Factors, then, which stimulate or inhibit cell division could profoundly alter the pathways of neurones and hence the fundamental pattern of the nervous system with resulting changes in behavior. Such control is undoubtedly present normally in all vertebrates Minor changes in the time relations of regulation may account for the development of amodal behavior in all forms but especially in man where the elaboration of the nervous system is greatest.

The developmental morphology of infant behavior pattern ARNOLD GESELL (introduced by R. M Yerkes) This paper reports methods and illustrative results of a systematic survey of behavior patterns throughout the first year of life The survey has been in progress for five years and has been accomplished through coordinated studies by research members of the staff of the Yale Clinic of Child Development The subjects were normal infants selected as to race, parentage and socio economic factors. Twenty-five children have been examined at lunar month intervals from four weeks through fifty six weeks of age The infants were observed in a specially designed clinical crib under controlled conditions The data cover the fields of posture, locomotion, prehension, manipulation, attentional regard, exploitive and adaptive behavior. The behavior of selected infants is being investigated in detail by photographic methods By means of a photographic observatory equipped with a one-way-vision screen it has been possible to secure systematic cinema records of characteristic behavior at fourteen successive age levels. In experimentally controlled situations, like the prehension of a pellet or the exploitive manipulation of three cubes, the cinema proves an effective tool for the registration and analysis of behavior pattern. The cinema registers the sequence within a behavior episode, it chronicles the developmental changes in pattern at successive age levels; it preserves an authentic record which may be subjected to objective and comparative analysis Each record incorporates its own time and space values which can be quantitatively expressed Four feet of 16 mm film embody 160 frames, which depict 160 phases of a behavior episode, 10 seconds in duration. Repeating such a behavior situation at six advancing age levels yields a developmental record with over a thousand cinema frames or pattern phases. Cinema records aggregating 85,000 feet have been classified and catalogued by library methods. Specimens from the photographic records and from the analytic protocols will be shown to illustrate the use of cinematography in the charting of behavior forms. A special reel will show simultaneously in juxtaposition the behavior patterns of the selfsame infant in an identical situation at 24 and at 28 weeks of age, giving an immediate instantaneous view of a developmental increment. Structurally regarded, the behavior complex of the infant has a meaningful morphology, reflected in the developmental sequence and characteristic patterning of behavior forms. Ascertainable laws of growth are suggested by the underlying orderliness of these behavior forms and sequences The cinema data in conjunction with the stenographic reports of the developmental examinations serve to define the increments and changing configurations of behavior growth. Systematically selected photographic records become the basis of an atlas delineating developmental trends Using such records, we have begun the compilation of "A Photographic Atlas of Infant Behavior Patterns"

The vitamin B requirement GEORGE R. COWGILL (introduced by L B. Mendel).

A photometric survey of the nearer parts of the metagalactic system HARLOW SHAPLEY and ADELAIDE AMES

The natural history of the vibrato CARL E SEASHORE This paper summarizes the present status of findings in an extended research program on the nature, the artistic legitimacy and significance, the variables, the evolution and development and the physiological basis of the vibrato in music and speech

Modes of infection in poliomyelitis SIMON FLEXNER The recent epidemic of poliomyelitis has raised again the question of the modes of infection in the disease. This question is being studied with respect to verminous and human agencies of carriage of the virus and the portals through which it penetrates into the body to reach the central nervous system. The results of this study will be presented

Genetic and histological studies on mouse leukemia: E. C MACDOWELL and MAURICE N. RICHTER (introduced by C B Davenport) Each of two strains of pedigreed mice has attained a high degree of genetic homogeneity by continuous inbreeding under the same external conditions over a period of nine years One of these strains is characterized by the regular occurrence of spontaneous leukemia in a high proportion of all the mice that survive the first six months, in the other strain no certain case of leukemia has been found. As already indicated by Slye's findings, these two strains demonstrate that spontaneous leukemia is under specific genetic control. The appearance of leukemia in the first hybrid generation (F_1) of a cross between these two strains proves that the genetic differential involved in the development of leukemia in one strain, and in its absence in the other, may produce leukemia in the heterozygous condition; that is, this differential is not a single recessive gene. The heterozygosity of the F_1 hybrids is manifest in a distinct reduction in the proportion of spontaneous cases as compared with the pure-bred susceptible strain—a situation that can not be interpreted in advance of further genetic analysis. The leukemia of any of these spontaneous cases can be transmitted to young mice of the susceptible strain by inoculations with suspensions of splenic lymphocytes. By successive inoculations thereafter the leukemia can be transmitted indefinitely from mouse to mouse with virtually 100 per cent susceptibility. In one of eleven lines of such inoculations the disease has been passed through 149 mice since leaving the mouse from which it arose spontaneously. The four lines of inoculations that have been carried for considerable periods agree in, (1) finding their requirements for susceptibility satisfied by mice of the susceptible strain, and also (2) by hybrids between the two strains, but (3) in no case in mice of the resistant strain, they also agree (4) in showing a marked increase in virulence during the course of the early transfers. On the other hand, the leukemias carried by these lines differ (1) in their requirements for susceptibility, as indicated by different proportions of susceptible mice in the same segregating generation following a cross between these two strains; (2) they differ in the interval before the culmination of the disease, (3) in the duration of the stage during which the mouse is obviously sick, (4) in the distribution of lesions as shown in gross autopsy as well as in the histological pictures—for example, in the appearance of a normal or enlarged spleen, and in the presence or absence of leukemic cells in the blood.

The active agent involved in these inoculations has power to reproduce itself indefinitely. It may exist in many subtle variations involving special affinities for infiltration of one or another organ or tissue. Those various states may be maintained constant for long periods of time through many passages or they may change with relative frequency. If the living cell itself is not this agent, the existence of the agent is very closely dependent on the life of the cell, in that innumerable attempts to separate the living cell from such an agent have failed. The parallels between the situation in leukemia, in which both the spontaneous occurrence and susceptibility to inoculation are under the control of genetic factors, and the situation in such neoplasms as have been studied by Little, Strong and Bittner, are remarkably close and stand as evidence towards a final analysis of the nature of leukemia.

Liver edema as a reflex response to cold. Henry G. Barbour (introduced by Y. Henderson). The onset of fever resembles the reaction of the body to cold. The shivering or "chill" produces extra heat, and this heat is saved by withdrawal of most of the surface circulation. That water is also lost from the blood has been shown for cold baths and many types of fever. What takes this water from the blood, and is this process significant for heat saving? Researches in collaboration with Messrs. H. T. Marshall and B. F. Aydelotte, of the University of Louisville, afford answers to both of these questions. We have shown that fever poisons (cocaine, beta tetrahydronaphthylamine, foreign serum in a sensitized animal) while concentrating the blood increase to about the same extent the water content of the liver. We have found the liver water similarly increased in "cold" fever, which is produced by direct application of cold to the thermostatic region of the rabbit's brain. Microscopic sections of such livers show the cells swollen with water at the expense of the canals which drain the liver. But after the sympathetic nerves to the liver are cut, the rabbit's blood no longer becomes concentrated when the brain is cooled. Further, a normal dog subjected to cold baths yielded an average serum specific gravity increase of .0035. The same animal after liver denervation showed an average specific gravity increase of only .0012. This would indicate that the liver takes up two thirds of the lost blood water. Small samples of two dogs' livers were also removed under local anesthesia, with the animal at complete rest. Before applying icepacks to the chest and thighs the respective livers contained 71.8 per cent and 72.4 per cent of water. After about one half hour of such chilling the same livers contained 73.7 per cent and 73.1 per cent. It seems apparent that by a reflex response to cold, acting through the brain, the liver is induced to take up water. In the last experiment cited the liver glycogen fell from 2.8 per cent to 2.1 per cent, a well known phenomenon which tends to create a demand for water by increasing the osmotic pressure. How does removal of water from the blood to the liver save heat? Whenever extra heat is produced, if the body is to retain a normal temperature extra heat loss is demanded. A familiar instance is exercise. Here the demand for heat loss is met largely by the pouring out of water for evaporation on the body surface—sweat in man, saliva in the dog and extra water loss through the lungs and skin of mammals in general. In five rabbits we have carefully followed the water loss in the onset of cocaine fever. It is very striking that during the first half hour of temperature rise the water loss shows no significant increase. It actually decreased in two of our experiments. This lag occurs while the liver is taking up water and the blood is concentrating. Evidently the liver can thus retard surface evaporation and delay the onset of sweating. Later on, the fever temperature being established, the water loss may be doubled or trebled. The water loss from the body then seems to keep pace with that from the liver, for an average rabbit with cocaine fever loses by evaporation 3 or 4 cc extra water per hour. This is just the rate at which the liver releases its extra water, as shown by determinations from animals killed in the various stages of fever. Thus the liver plays a significant rôle in the mechanism by which the body saves heat in response to cold or in the onset of fever.

Organs capable of producing acetone substances. H. E. Himwich. Muscle of the normal mammal oxidizes both fat and carbohydrate, the latter in the form of sugar. Since insulin is needed for the oxidation of sugar, muscle of the diabetic animal burns fat only. On the other hand, the character of oxidations in the brain is unchanged by diabetes, since the brain, which utilizes carbohydrate exclusively, transforms sugar to lactic acid before oxidation and lactic acid is oxidized without the aid of insulin. Unless carbohydrate and fat are oxidized simultaneously, fat can not be completely burned and toxic end-products, the acetone substances, accumulate.

Thus only organs which oxidize both fat and carbohydrate, the latter in the form of sugar, are capable of producing acetone bodies during diabetes.

The relationship between chemical composition and taste ARTHUR L. FOX (introduced by A F Blakeslee) In working with phenyl thio carbamide an accidental discovery disclosed the fact that this compound is taste less to certain individuals, while to others it is extremely bitter As slight alterations in chemical structure often cause great changes in physical or physiological properties it was considered of interest to determine whether this property existed in other related compounds Therefore a large number of related mono aryl thio carbamides were investigated, and most of them were shown to possess the same property Then symmetrical di aryl thio carbamides were studied and were also shown to possess similar physiological action Various other thio carbamides were studied, but in almost every instance the same result was obtained So far only two compounds have been found which deviate from the class to which they belong, but this deviation is believed to be due to insolubility

Genetics of sensory thresholds —taste for phenyl thio carbamide ALBERT F BLAKESLEE Dr A L Fox first showed that many people can not detect the bitter taste in crystals of phenyl thio carbamide In an earlier publication, Salmon and I showed that taste deficiency for the crystals appears to be inherited as a Mendelian recessive (The same conclusion has been reached independently by L H Snyder) In addition to "non tasters" of the crystals, we were able to classify the "tasters" of the crystals roughly according to their taste acuity by means of dilutions at which the bitter taste was first detected This work on taste thresholds has been extended. Thresholds for the "tasters" have been established from 1 500,000 to 1 5,000 dilutions These extreme thresholds are rare The commonest threshold is at about 1. 80,000 With a few possible exceptions, none could taste the pure crystals who could not taste bitterness in a dilution of 1· 5,000 Tests of thresholds in about 100 families indicate that acuteness of taste for the chemical is inherited, since there is an obvious correlation between the thresholds of parents and children It has been the practice to test people with the dry crystals if they could not detect bitterness in a 1 5,000 solution and to classify them as "non-tasters" if they did not report the crystals as bitter It is now found that phenyl thio carbamide is also bitter to "non tasters" for the crystals if the chemical can only be gotten to their sense organs in a sufficiently concentrated form. Most "non-tasters" can detect bitterness if a cold saturated solution is used The few who are still negative to this test have been found to taste bitterness in a saturated solution in hot water or still better in hot weak alcohol. Many who could detect bitterness in relatively weak solutions were unable to taste the pure crystals, but, so far as retested with saturated solutions, they were found to react positively. Inability to taste the crystals may have something to do with differences in salivas as well as to differences in sense organs. A few could not detect bitterness in phenyl thio carbamide solutions but reported a different taste. Some said it was sour, some called it peppery and others described it as astringent like alum. There is evidence that a condition analogous to color blindness exists in regard to taste in that two substances which taste differently to most give to some the same sensory reaction. Thus two persons, who were given a special test, were unable to distinguish quinine from hydrochloric acid. Some tasted bitterness in weak concentrations but could perceive little difference between the various test solutions, each of which was four times as strong as the one previously tasted Others showed reactions corresponding to the relative strengths of the solutions There was no close relation between emotional response and threshold at which the taste was first perceived. Taste acuity for phenyl thio carbamide was found to have no close relation to taste acuity for other bitter compounds —picric acid and quinine sulphate—which also afford a wide range of thresholds Likewise there was no close relation found with acuteness of taste for an acid and for a sweet Differences in taste thresholds for a number of other substances have been found by us and other investigators The same is true for odors In the single case investigated we have found these differences in powers of sensory perceptions innate and hereditary Evidence is thus given for the belief that humans are born with innate differences in respect to all their senses and that different people live in different worlds, therefore, so far as their sensory reactions are concerned

Glucoside formation in methylated glucoses P A LEVENE and A L. RAYMOND The ring structures of the γ- and normal glucosides of the fully methylated sugars have been established beyond dispute, whereas those of the non substituted sugars have continued to be a matter of discussion The structure of the normal glucosides of the non substituted sugars has recently been demonstrated to be that of a pyranose so that there remained for consideration only the γ glucosides of the non-substituted sugars For these the butylene and propylene oxidic structures are under consideration To choose between these two possibilities, a study has been made of a 3 monomethyl and a 4-monomethyl sugar as regards their glucoside formation It was found that while the 3 methyl sugar gave two glucosides, a normal and a typically γ-, the 4 methyl gave only a normal glucoside This would seem definitely to exclude the propylene oxide structure and favor the assignment of the butylene oxide structure to the γ glucosides In support of this view is the fact that the rate of glucoside formation in the case of the 4-methyl sugar is similar to that of tetramethylglucopyranose, which has only position 5 unsubstituted

Artificial hormone substances· TREAT B JOHNSON. The synthetic organic chemist is very much interested in the study and preparation of artificial substances which may prove to be of practical value in the prevention and cure of diseases. He is very desirous of utilizing the resources of his science in every way possible for the benefit of mankind Both the animal and plant are productive in their growth of active principles which exert a pronounced physiological action when liberated in the living organism, and their separation and utilization by man has contributed greatly to the advancement of almost every field of medicine. We have adopted the materials that nature provides for us, and we have also gone further and modified these materials, purified them, and have been extremely successful in making many new combinations of great medical value We are now advancing to the third stage of this program in the development of drugs for the use of man, and it is the organic chemist who now seeks to duplicate further the natural products to produce new organic derivatives from them and to prepare in his laboratory entirely new compounds related structurally to the natural substances and finally to create artificial materials which may serve as practical substitutes for nature's products Among the many substances formed in the animal metabolism are the glandular secretions which our physiologists have designated by the general term, "hormones" These interesting products are secreted in animal economy in extremely small quantities, but they are very powerful in their physiological action, and it is known that an animal can not live and grow without their aid These active substances serve in animal metabolism as chemical messengers, so to speak, and they exercise a very fundamental part in regulating all the normal life processes In other words, without the proper functioning of these glandular organisms which produce these secretions, man can not live. Thyroxine and adrenaline are two important representative organic substances which are found in the secretions of special glands, and they represent two of the most important substances which we classify under the term "hormones" It is an interesting fact that the structures of both of these substances have been established, and the chemist has been able to prepare both of them artificially We are, therefore, now able to produce two of these important hormone principles in our laboratories, and are therefore not dependent for their supply on natural materials It is an interesting fact that, as a result of advanced research by the organic chemist, absolutely new organic constructions can be synthesized which show almost the same physiological activity of many of these hormone principles which nature provides for her service. When substances of this type are obtained by the organic chemist, their structure established and their physiological activity shown to duplicate the materials found in nature, they are spoken of as artificial hormones The substances discussed in this paper belong to this class of compounds They represent new compounds which have never been prepared before and have been found to show a physiological activity which duplicates that of natural hormones of certain types, and therefore are of extreme interest to the chemist and call for an exhaustive study There is a great probability that some of these organic combinations will be found to be perfect substitutes for natural hormone compounds and lead to products which are far superior in their physiological activity to those already produced by nature. The field of investigation is a most inviting one to the chemist, and the thiazol compounds which have been chosen as a group of compounds deserving of chemical attention offer possibilities of synthesis which are not common to many classes which the chemist can select for his work. It is possible to prepare, in the series under investigation, compounds, for example, that are far less toxic than the natural hormone—adrenaline—and still retain a physiological activity that promises a possibility of very practical application in medicine This work has been in operation in the Sterling Laboratory for the past four years, and a program of work has been mapped out which will keep certain members of the staff occupied in this field for a long time

The influence of complex salt formation on the electronic structure of iron oxides OSKAR BAUDISCH (introduced by T B Johnson).

Further studies of rate of growth of albino rats ARTHUR H SMITH and W E ANDERSON (introduced by L B Mendel)

The Arizona expedition for the study of meteors. HARLOW SHAPLEY, E J OPIK and S L. BOOTHROYD.

The adequacy of ocular compensation to bodily rotation G R WENDT (introduced by Raymond Dodge) Graphs will be shown (by lantern slides) which show the relationship between the velocity of the slow phase of vestibular nystagmus and the velocity of bodily rotation. Using normal college students as subjects, and photographically recording eye-movements through closed eyes by the Dodge mirror recorders it has been found that in the simple conditions of rotation used in this experiment ((1) translation through 65 degrees in two seconds, (2) harmonic oscillation through 15 degrees) the velocity of compensatory eye-movements bears a constant relation to the angular velocity of rotation. The velocity of the eyes at any moment is found to vary directly with the velocity of the head. Related to earlier work by Dodge, his collaborators and others, it will be pointed out that these results make definitively untenable the notion that vestibular stimulation operates on the reflexes by acceleration alone. In these experiments the response of the eyes is not related to acceleration but to velocity

(To be concluded)

BOOKS RECEIVED

BENTLEY, WILSON A. and W. J. HUMPHREYS. *Snow Crystals.* Pp ix + 227. Illustrated. McGraw-Hill. $10 00.

FRASER, RONALD G. J. *Molecular Rays.* Pp. vii + 204. Illustrated. Cambridge University Press, Macmillan. $3.75.

MCCLENDON, J F. *Handbook of Chemistry in Biology and Medicine.* Part One: 206 pp. Part Two: Pp. 207–397. Part Three: Pp. 398–462. J. F. McClendon, University of Minnesota.

MCMATH, FRANCIS and others. *Some New Methods in Astronomical Photography, with Applications to Moving Pictures of Celestial Objects.* Pp. 53–78 Illustrated. The Observatory, University of Michigan.

RUDWIN, MAXIMILIAN, *The Devil in Legend and Literature.* Pp xi + 354. Illustrated. Open Court. [illegible]

SCIENCE

VOL. 74 FRIDAY, DECEMBER 18, 1931 No 1929

What Does Einstein Mean? PROFESSOR J FRENKEL 609

Physiological Time. DR ALEXIS CARREL 618

Obituary:
Memorials, Recent Deaths 621

Scientific Events
Wellcome Research Institution, New Bird Sanctuaries, The Seventh American Scientific Congress, Award of the Edison Medal to Dr. Edwin W Rice, Jr. 622

Scientific Notes and News 625

Discussion
A Submerged Beach off Bermuda WILLIAM BEEBE *Position of Wood in Beaver Dams* CHARLES MACNAMARA *Virginia Geological Survey Field Work* DR. ARTHUR BEVAN. *Poisoning Rodents—and Then?* A B HOWELL. *Treatment for Poisoning by "Poison Ivy"* PROFESSOR MAYNARD M METCALF 629

Scientific Apparatus and Laboratory Methods
Testing the Reaction of Distilled Water PROFESSOR EMIL TRUOG *A Method of Copying Kymographic Records* DR. WALTER C ALVAREZ. *Apparatus for Observation of a Small Object while Flooded with Various Solutions* ERNEST C. MCCULLOCH *A Simple Device for Holding Ultrafiltration Membranes* CHARLES BREEDIS 633

The National Academy of Sciences. III 635

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City. Grand Central Terminal
Lancaster, Pa. Garrison, N Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C.

WHAT DOES EINSTEIN MEAN?[1]

By Professor J. FRENKEL
POLYTECHNIC INSTITUTE, LENINGRAD

I AM not sure that I shall fully succeed in explaining during this hour what relativity is, but I shall be satisfied if I succeed in at least removing some of the prejudices which have arisen in connection with this question. Relativity is so simple that the greatest difficulty in understanding it lies in getting rid of one's prejudices. It is really remarkable that Einstein, who is certainly the most popular scientist in the world, is the author of the most unpopular theory in the world. I think a greater harmony should prevail in the popular mind between the man and his work.

One of the common prejudices concerning the theory of relativity is the idea that according to it everything is relative. Nothing could be more incorrect than this assumption. The theory of Einstein states that many things, many notions, many qualities which we thought absolute are actually relative, but on the other hand it destroys the old absolutes only to build up new ones. It could be called, with better right perhaps, the theory of the absolute and not the theory of relativity It introduces relative quantities only in order to build up absolute quantities out of them and to build up rules for connecting them which will be absolute and which will express physical laws. Maybe if the theory of relativity were called the theory of the absolute it would not appeal so much to the present sophisticated generation, and there would be less talk about it.

Another prejudice is the idea that the theory of relativity was entirely created by Einstein It was prepared for by the work of Newton. The relativity of space was incorporated in Newton's work; Einstein extended this so as to include the relativity of time.

In his celebrated "Principia" Newton started by saying that space is absolute and that space is at rest: also, he added that time is absolute and flowing uniformly without any connection with other events. Let us leave time alone for a while, and consider what

---

[1] Address before the Minnesota Chapter of Sigma Xi.

Newton meant when he said that space is absolute and at rest.

I have heard that Ibsen was asked once as to what he meant by one of his plays, and he answered that when he wrote it only God and himself knew what he meant, but since then he had forgotten! I think Newton would say the same thing about his absolute space which is at rest, because from the results established by Newton himself it followed that it is physically impossible to discover and furthermore to determine what this "rest" meant. If some frame of reference is supposed to be at rest, and then another frame of reference is introduced which moves uniformly and in a straight line with respect to the first, then all the events will take place in exactly the same way with respect to the second "moving" frame as with respect to the first, which was supposed to be at rest, and therefore, so far as we can judge from physical phenomena, there is no difference whatever between the two systems of reference—both of them could, with equal right, be supposed to be at rest.

This statement expresses an experience which is very familiar to all who have had the opportunity of riding in a car, ship or train. You feel just as comfortable on a uniformly moving train or ship as you do in a room in a house. One does not notice the uniform motion. All events that happen on a uniformly moving car will take place in exactly the same manner as they take place with respect to the earth, and therefore we do not have any reason to say the earth is at rest and the car is moving.

The same result can be derived mathematically from the fundamental laws of motion established by Newton, thus disproving his original assertion that one can talk about an absolute space that is at rest. The first relativistic idea which we have to introduce is the relativity of uniform rectilinear motion. Given two systems moving with respect to each other uniformly and in a straight line, either of them can be considered as being at rest. From this relativity of motion, or more exactly of uniform motion, there follows the relativity of distances between points in space, so far, at least, as these points refer to events taking place at *different times*.

Let us speak more concretely. Suppose you are riding on a train and let us say are walking forward to the diner: you start at one moment and you arrive a few minutes later at the diner. What is the distance you have moved? It depends on how you measure it. If you measure it relative to the train it will be a rather short distance, perhaps 200 or 500 feet. If you measure the distance traveled with respect to the earth it would be an entirely different quantity, which depends upon the speed of the train. It is not necessary, however, to confine yourselves to the earth: you could take into account the motion of the earth in space. You could, for example, refer the motion of the earth to a frame of reference which is fixed at the center of gravity of the solar system, and then it would turn out that the distance you had moved was not 500 feet or the few miles that the train moved during this time with respect to the earth, but it was perhaps a few hundred or a few thousand miles, since the earth has moved with respect to this frame of reference fixed at the center of gravity of the solar system. And there is also no reason to use that particular system of reference. You could refer the motion of the solar system to any other coordinate system, and then it would turn out that the distance through which you moved was perfectly indefinite: it may have been 100 yards, or 100 miles or a million miles.

Now, this indefiniteness is the result of the fact that one can not define in an unambiguous way a point in empty space. It can be defined only with reference to some coordinate system. If you take two coordinate systems which move with respect to each other, then the distance between the point from which you started and the point to which you have arrived will be different for the two systems. Take, for example, a coordinate system which is moving with you. With respect to this system you will always be at rest, the distance traveled being in this case zero.

So the distance between two points is a perfectly relative quantity, at least so far as these two points relate to events corresponding to different instants of time. You can say, for example, that I have been staying at the same place from the beginning of my talk, which will be true if you consider the room and earth at rest. If you take into account the motion of the earth with respect to the center of gravity of the solar system, all of us have traveled quite a long distance during the ten minutes that I have been talking.

So you see, if uniform motion is a relative motion, then distance in space is also relative or, rather, indefinite. To this principle, however, an important amendment would be made by one adept in the old Newtonian theory, namely: That it is true if you consider the distance between points referring to events which take place at *different times, not simultaneously*. The distance between two points, considered at the same instant of time, was assumed to be absolute, *i.e.*, independent of the choice of the coordinate system which was supposed to be at rest. The definition of "rest" would be immaterial in this case, because so long as the notion of simultaneity is considered as absolute, *i.e.*, independent of the definition of rest or motion, the latter can not affect our estimate of the distance between two points visualized at the same time, the distance traveled by ourselves (or our system of reference) in no time being zero

Here, then, I must warn you against a misunderstanding When I am talking about the distance between two objects, I am thinking of the points of space with which these two objects coincide at their respective instants of time When I am thus thinking of two objects at the same instant of time, then the distance between these two objects or the points of space which they occupy at the same instant of time will be independent according to Newton's theory of which coordinate system we assume to be at rest So you see that the distance between two points is relative so far as they refer to non-simultaneous events, but it is absolute if they refer to simultaneous events

This absolute character of the distance between points referring to simultaneous events was connected in the Newtonian theory with an absolute character of simultaneity It was thought in the Newtonian theory that the notion of simultaneity was an absolute notion, that the notion of the interval of time between two events was unambiguous, in contradistinction to the notion of their distance in space We thought that we could talk of a definite instant of time for the whole universe and could accordingly define a lapse of time as something definite for all the universe, irrespective of the coordinate system supposed to be at rest and to which we refer the places of all the events observed.

Thus the Newtonian theory was only semi-relativistic It was relativistic with respect to space and distances in space so far as time was not concerned Considering different points at the same instant of time one admitted that the distances between them also become absolute, because simultaneity was thought of as an absolute notion

Now let us inquire why it was that the Newtonian theory admitted the possibility of defining an instant of time unambiguously for all the universe I am sure that in this respect you all or most of you are the faithful followers of the Newtonian theory, and you probably also think there is no reason why you should not be able to define simultaneity in this absolute way. Now, if you think about it you will see that there was a physical reason which seemed to justify the assumption as to the possibility of defining simultaneity unambiguously (*i e*, independently of the coordinate system) for the whole world. This physical reason lies in the Newtonian conception of *force* or *action*. After all, how can you ascertain that two events taking place in different places, on different planets, for instance, are simultaneous? Only through some action coming from these two planets, and such action need not be the action of light it is sufficient to assume that there is *some* action which can be transmitted from these two planets to the earth instantaneously If such action existed we should theoretically be able to justify the notion of simultaneity as applied to events in different points of space.

Now, this was exactly the Newtonian and post-Newtonian notion about the transmission of forces through space. It was thought until the second half of the nineteenth century that forces could be transmitted instantaneously through space We are so used to this notion that we don't even notice how it slips into our arguments When a physicist talks about the force of interaction between two bodies, as determined by the relative position of these bodies, he fails even to mention that he thinks of the simultaneous position He considers this simultaneity as something self-understood

When he thinks, for instance, of the action which the earth experiences from the sun, the moon and the other planets, he usually assumes that this action depends upon the simultaneous position of all the other celestial bodies He thus assumes that this action is propagated through all space instantaneously. It is this idea of the action at a distance which is propagated through space with infinite velocity that forms the basis of the assumption that simultaneity can be unambiguously defined If you can theoretically imagine that the whole world can be embraced by some sort of action at a certain instant of time, then it is reasonable to talk of simultaneity as of something definite, which is independent of the choice of the frame of reference

This idea of force, as propagated instantly through space, was developed with the Newtonian theory of gravitation as a model for forces of all other kinds. It was assumed that gravity was a force acting at a distance through empty space and transmitted with infinite velocity Newton did not attempt to understand the nature of gravitation He was satisfied with the recognition of the fundamental fact that gravitational forces were very similar to the forces of inertia connected with accelerated motion, both being proportional to the quantity which is defined as the mass of the body Newton did not go beyond that, and further, in the Newtonian theory, the relativity of motion could not be generalized for non-uniform motion, *i.e*, for motion which is connected with acceleration It was supposed that acceleration, *i e.*, the rate of change of velocity, was absolute and that relativity suffered a breakdown when applied to accelerated motion

So you see that there was already a relativistic theory in the old physics created by Newton, but it was limited to space, it did not affect time, and further it was limited to uniform motion. Now let us see what Einstein changed in this situation, and what was the basis of this change

Einstein's theory did not come just like a "Deus ex machina," that is, completely unexpected It was prepared for also by the development of physics in the second half of the nineteenth century. The fundamental results of this development consisted in the following facts (1) that all physical forces with the exception of gravity were reduced to electrical forces due to the invariable electrical charges of the elemental particles of matter, namely, the electrons and protons. and (2) that electrical forces are propagated through empty space with a finite velocity, whereas gravitational forces formerly were supposed to be transmitted through empty space with infinite velocity

Now, this velocity with which all physical forces, so far as they are of electrical origin, are propagated is equal to the velocity of light This coincidence is due to the simple reason that light is itself an electric phenomenon In the present era of radio everybody knows that electrical vibrations generate electromagnetic forces, which are propagated through space in the form of "electro-magnetic waves" with the same speed as light, light vibrations differing from these radio vibrations in frequency or wave-length only In the case of light, the wave-length is about one billion times shorter than in the case of radio waves, this difference being due to the minute dimensions of the atoms of matter which act like broadcasting stations in the case of light waves

Therefore, the coincidence of the velocity of light with the velocity of propagation of electrical forces is simply the expression of the fact that light is one of the manifestations of electricity If in the sequel I refer to this velocity as the velocity of light don't think that I am particularly stressing the optical side of physical phenomena.

Now, leaving aside for a while the forces of gravity, let us assume that all physical forces are propagated with a finite velocity—the velocity of light. What is the implication of this principle with respect to the definition of simultaneity? I mentioned before that the absolute character of simultaneity in Newton's theory was justified by the idea that one could embrace all space at a single instant of time by a physical force emanating from some material body. We now see that this is wrong. A physical force produced by any material body will spread in space with a finite velocity, and thus we lose our solid foundation when we speak of simultaneity as something absolute. This is the real physical basis for the "relativation," so to speak, of time.

The relativity of time follows from the impossibility of combining (by means of a physical action) what is separate in space This principle could be the starting point of Einstein's theory The path which is pursued by pioneers of scientific discovery is often more complicated than that which we can follow when we know the goal at which we must arrive. Einstein's path was more complicated than the one which I am indicating now—but let us continue on along this straightforward path I shall at the conclusion of my lecture come back to the more sinuous path which was followed by Einstein, a path that was obstructed by a lot of prejudices which had to be destroyed.

There is no reason whatever, therefore, for assuming that events, separate in space, can be unified in time. There is no reason why the distance in time between two events taking place on different planets should be a perfectly definite quantity (*i.e.*, independent of the choice of the frame of reference supposed to be at rest) It may be just as indefinite as the distance between the points of space where these two planets were at the initial moment It may be perfectly possible that the distance in time between two events taking place in Jupiter and Mars will appear different to an observer on the earth and one on another planet, if there were any such.

We are left now, so to say, with no criterion for the comparison of the intervals of time between two events as they must be determined by observers connected with two different systems. I must again warn you against a prejudice. It is sometimes admitted that the Einstein theory changes our ideas of time and space, time particularly, in a very fundamental way Now, so far as we are considering events with reference to one particular frame (supposed to be at rest) relative to this room for instance or the earth, etc.—Einstein's theory does not change anything about our notions of time and space. Einstein's theory refers to the comparison of space and time intervals between given events as measured or determined with reference to different coordinate systems, which are moving uniformly with respect to each other and in a straight line, either of which may be assumed to be at rest.

Now, how shall we correlate the determinations of the time interval between two definite events by two observers, which are connected with different systems, moving with respect to each other? This question can be solved with the help of that very fundamental principle that is bringing us to the relativity of time, namely, the finite speed of the propagation of physical action. Here is a very delicate point which also gives rise to considerable confusion and which we must carefully elucidate.

Einstein's original (restricted) theory is based on the relativity of space so far as it depends upon the relativity of uniform rectilinear motion (*i.e.*, motion with a constant velocity). Now, if motion is relative, then velocity must be relative also: the velocity with which something is moving, with which, for instance, force is propagated. This velocity should therefore be a quantity, which depends upon the choice of the system of reference supposed to be at rest. This seems perfectly natural: if motion is relative, velocity also is relative. We have just said on the other hand that physical actions are propagated through empty space with a definite velocity equal to that of light, *i.e.*, 187,000 miles per second. This velocity being relative, *i.e.*, being definable only with respect to some frame of reference supposed to be at rest, must at the same time be definite, *i.e.*, independent of the choice of this system. Now this looks like a contradiction. It seems to follow from the relativity of velocity that it also should be indefinite, *i.e.*, that its value should depend upon the choice of the "resting" frame of reference, and it seems impossible to make an exception in the case of any particular velocity, that of light, for example.

If it were so, however, the propagation of light and of physical forces in general would be a physical phenomenon which would enable us to discriminate between two systems of reference moving with respect to each other. If light were propagated in a different way with respect to two such systems then we certainly could say that the systems have different states of motion, *i.e.*, different velocities with respect to "empty space." That coordinate system with respect to which light is speeding with the same standard velocity 187,000 miles a second in all directions could be defined as being truly at rest and all the other systems with respect to which the velocity of light would be different, say in different directions, could be defined as truly moving. But the notions "true" motion, "true" rest, "true" velocity mean that rest, motion and velocity can be defined in an absolute sense with respect to empty state as the fundamental frame of reference supposed to be at rest. This would mean that one must give up the idea of relativity of motion.

But how can we give it up if space is actually void, if it does not contain anything? How can we speak of motion in an absolute sense? When Newton said space is absolute and at rest he did not seriously mean what he said, and we can not seriously mean to say that we can define the real or true velocity of a body with respect to empty space.

If therefore there is a relativity of motion then all velocities must be relative including of course the velocity of light, which, however, must be absolute in the sense that it must be the same whatever the system of reference, supposed to be at rest, with respect to which it is measured. Is it really a contradiction to assume that the velocity is relative in the sense that it can be defined only with respect to a coordinate system which is arbitrarily supposed to be at rest and that at the same time it is absolute in the sense that it is independent of the choice of this system? There is no contradiction between the two statements because the words "relative" (in the former) and "absolute" (in the latter) are used in entirely different senses. I should prefer, in order to escape confusion, to use two different words in the two cases. The term "relative" should be used with respect to velocity in the sense that velocity acquires a definite magnitude only with respect to some coordinate system which is assumed to be at rest: the velocity of light is no exception to this principle—it acquires a definite value only with respect to a system which is supposed to be at rest. As far, however, as any other velocity is concerned not only its definition but also its magnitude depends upon the choice of the "resting" coordinate system. Such velocities are therefore variable or indefinite. The velocity of light, or more exactly the velocity of propagation of all physical actions, enjoys an exceptional position in the sense that being relative it is at the same time definite, invariable or as they usually say in mathematics "invariant" (which does not mean that it is absolute). The invariant character of the velocity of light was established experimentally by Michelson, who tried without success to detect a difference in the velocity of propagation of light rays with respect to the earth (assumed to be moving in space) in different directions. Without by any means questioning the historic importance of Michelson's experiments we can say at present that these experiments were actually useless. If physicists were not prejudiced by the idea of the ether, a material medium in which light vibrations were supposed to be propagated, they would have come to the fundamental ideas of the theory without any experiments on the propagation of light relatively to the earth. For we know now, after the ether theory has been done away with, that if it turned out that light were propagated with different velocities in different directions with respect to the earth then there would be a meaning in talking about the absolute velocity of the earth with respect to empty space, but we have too much confidence in our intelligence to assume that such a notion has any physical meaning.

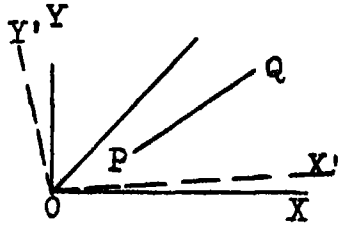
Let us now see what are the consequences of the two principles, that every velocity is relative, and that the velocity of light being relative is invariant (while all the other velocities do depend upon the choice of the coordinate system). Let us consider, for example, the propagation of a radio signal from one ship to another ship, the first one being anchored and the second moving with respect to it. Let us suppose that the anchored ship is sending a radio signal to the moving ship. What is the distance traveled by the signal and the time which it used to travel this distance? The distance between the point of space from which the radio signal issued and the point of space where it arrived will depend upon the choice of the frame of reference which is supposed to be at rest. If this frame is connected with the anchored ship, then the point of arrival will be that point of space where the other ship is located at the moment of arrival, this point being displaced with respect to its position at the moment when the signal was emitted by the first ship by the distance the second ship is supposed to move while the signal is speeding towards it. If, on the other hand, the frame of reference is connected with the second ship, which is thus supposed to be at rest, while the anchored ship moves with the earth in the opposite direction, then the point of issuance will be that point of space where the anchored ship was at the moment of sending the signal, and the point of arrival can be identified with that point of space where the second ship was situated at the same moment, since it is assumed that it remains at rest Thus the distance traveled by the radio signal must be different from the points of view of the first and of the second ship

Now what about the time? Will the time elapsed between the sending of the signal and the receiving also depend upon the choice of the frame of reference supposed to be at rest? Not according to the old theory, which says that this time is a perfectly definite thing and that it must be the same for any reference system This would imply that the velocity of propagation of the radio signal is indefinite—that it should depend upon the choice of the coordinate system supposed to be at rest

Now we can say that this is not true The velocity of light or radio waves must be the same with respect to any frame of reference Since, on the other hand, the distance must be different for frames of reference moving with respect to each other we are forced to the conclusion that the interval of time between two definite events, between emission and receipt of radio signals in our example will be also different We are thus forced to abandon the old dogma of the absoluteness and invariance of time It would be considered as a big sacrifice if we persisted in thinking that we could define time in an absolute manner for the whole of space, that we could grasp the whole of space at a definite instant of time by means of some instantly transmitted physical action. Now we know that this was a wrong pretense, that what is separate in space can not be united in time, and there is therefore no obstacle whatever to giving up the idea that "duration," the time interval between two events, must be the same as estimated by two different observers moving with respect to each other We shall willingly give it up, but how shall we get the correlation between the different times as determined by different observers? Now it can be easily seen that it is just this invariance of the velocity of light, for the sake of which the absoluteness of time has to be sacrificed, which enables one to establish the above correlation, i e, to compare the measurements of time by different observers. We can say that the intervals of time between two definite events—the issuance of the radio signal by the first ship, and its reception by the second as determined with respect to two different frames of reference—must stand in the same ratio as the corresponding distances, so that the ratio of the distance to the time, equal to the velocity of light, should be the same in both cases

If we did not have this principle of the invariancy of the velocity of light we would have absolutely no way of comparing the determinations of time by different observers It is only this principle that allows us to compare the estimations of time. An important point that should be mentioned here is that the theory of relativity allows the invariance of one velocity only (that of light) It would be impossible to build up a consistent theory of time and space if we had to insure the invariance of two or more different velocities Thus Einstein's relativity theory is based on the unique character of the velocity of light

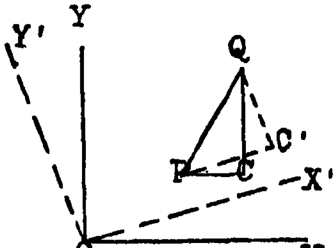
The preceding results can be illustrated in a graphical way which I think will help one to understand them. We physicists are used to represent motion graphically I hope all are acquainted with the principle of this representation We draw two (usually) perpendicular axes OX and OY Let distances be represented along the first and times along the second A point P on this diagram represents an event whose place is given by its distance along X and whose time is indicated by its distance along Y The projections of the line PQ where the points P and Q represent two definite events represent the space and time distance between these events A succession of points, i.e, a line, represents motion Straight line corresponds to uniform motion (taking place in a definite direction) A vertical line represents motion with zero velocity, i e, motion "in time" (without any change of position). So we can say a vertical line represents rest while an inclined line represents motion, the angle of inclination being a measure of the velocity of this motion



Relativity of motion on this diagram can be interpreted as relativity of direction of inclination We can just as well assume that the line OY is vertical, thus representing rest, while the line OY′ is inclined and thus represents a point in motion, or that OY′ is vertical and OY inclined and representing motion in the opposite direction At the present time, in the twentieth century, it is very easy to realize this relativity of direction and of vertical direction in particular The vertical direction is not the same for different points of the earth's surface, for New Yorkers or inhabitants of Paris It is not a definite direction in space, as we imagined it to be in our childhood, it is a quite indefinite direction, so we can take any direction as vertical Therefore the notion of inclination will also be relative It depends upon what we take as vertical, and this relativity of inclination represents the relativity of motion or of velocity

Now, let us take these two points, representing two events, P and Q As has been mentioned above, the distance between the places of these two events and the distance between the times of these two events will be measured by the projections of the line PQ on the coordinate axis They will thus be equal to PC and CQ, respectively, with respect to the coordinate system XOY (OY being the axis of time, *i e*, the "vertical" line representing rest)

Let us now take another system of coordinates X′OY′, with the time or "rest" axis represented by the "inclined" line OY′. The projections of PQ on this new axis will be represented by PC′ and C′Q they will be different from PC and CQ and will thus represent a different distance in space and a different interval of time. So far as distance in space is concerned, this is a perfectly natural thing we are already prepared to admit in the Newtonian theory It is the difference in the estimation of time, as measured by CQ and C′Q, that constitutes a result which is characteristic of the new relativity theory



But is there anything that remains invariant that does not change here as we pass from one set of coordinates to another that has the same value for both sets? This is the "space-time distance" PQ It remains the same, whether we measure it in one set of coordinates or the other. We thus see that while the theory of relativity destroys the absolute character of notions which we thought absolute, it introduces instead new notions which are absolute, which do not depend upon the choice of the coordinate system which is supposed to be at rest

I must now say a few words about the measurement of space distance between events assumed to be simultaneous, for instance, the length of a rod, moving parallel to its length It is stated in popular presentations of relativity that such a rod should suffer a longitudinal contraction Why should a thing contract when it is moving and how can one speak of a definite contraction if motion is relative? As a matter of fact, it does not contract at all This belief in a contraction is a prejudice and misunderstanding We must clearly understand what we mean when we talk about the length of a moving body This length, *e g*, the length of the rod, is defined as the distance between that point of space at which one end of the rod was at a definite instant and that point of space where the other end of the rod was at the same instant It is the distance between two different points in space with which the ends were supposed to coincide at the same instant that is to be regarded as the length of the rod

Now what does "the same instant" mean? That is not a perfectly definite notion What seems simultaneous in one frame of reference (supposed to be at rest) will not be simultaneous in another The distance between two points of space where the ends of the rod were "at the same time" will be different, depending upon the choice of the coordinate system If this distance turns out to be smaller in a frame of reference with respect to which the rod is moving than in a frame of reference with respect to which it is at rest, it does not mean a real contraction, but a perfectly natural variability of length, depending upon the relative character of the definition of simultaneity

I can illustrate this by the following example Suppose we want to measure the height of a tower You could define this height by saying that it is equal to the distance from the bottom of the tower to the top. Now is this definition correct? It is certainly correct from our Minneapolis point of view, but let us be more broad-minded and let us give ourselves the point of view, say, of the New Yorker We don't have to go to New York and look through a telescope at the tower, but we have simply to replace the Minneapolis vertical by the New York vertical What will be the height then? It will not then be the distance from top to bottom—it will be the projection of this distance on the New York vertical line (which seems an inclined one from our point of view). So you see in Minneapolis the building has only a height, but with respect to New York it has a height which is smaller and also a length which is equal to its projection on the horizontal plane at New York. Let us now cross the Atlantic and go to Moscow, say Then the Moscow vertical will be parallel to the Minneapolis horizontal and the Moscow horizontal to the Minneapolis vertical Thus from the Moscow point of view the building does not have any height at all, but only length. There is no mysticism about it, there is no trick to it, it is simply the result of the definition of height Suppose a telegraph pole just fell to the earth What would its height be? The distance from one end to the other would be the height when the pole was standing vertically. it will be the length when it is lying on the ground Exactly the same can be said about the estimation of distance in time and distance in space The former or "duration" can be compared to height, while the latter to length Both are projective quantities they depend upon the choice of the coordinate system, which is supposed to be at rest, i e, on the definition of rest. In spite of the relativity of height and length and the possibility of assigning to the same building various heights, that height which can be identified with the distance from top to bottom and which corresponds to such a choice of coordinates with respect to which the building will be vertical and will have a length zero—that height, I say, will be justly considered if not the "true" one at least as the most "natural"

The same can be said about definition of distance in time as well as of the distance in space If you have two different events, then usually you can do either one of the two following things Either you can choose such a coordinate system that the two events will seem to take place at the same point of space (the corresponding points on the XOY diagram will lie on the same vertical) and, the whole space-time distance will then reduce to the distance in time. This can be defined as the "true," most convenient and the most natural definition of the interval of time in the same sense as the height of the building in Minneapolis is the most convenient or natural height

Or you can select a coordinate system with respect to which the events will appear simultaneous but taking place in different points of space the distance between the latter can be defined as the most natural length of the line connecting the points of the two events (the ends of a rod, for example).

Lack of time does not permit my giving any further development of these considerations. I would like briefly to point out the chief importance of the relativity theory to physics. This importance does not consist only in this "relativation" of what we thought to be absolute Much more important is the other side of the theory, which is the establishment of new absolute things or invariable quantities and invariable relations between variable quantities because physical laws must be invariable or "invariant" laws, true irrespective of the definition of rest, *i.e.*, of the choice of the coordinate system with respect to which we are considering the various physical phenomena

As a compass is to a sailor, so relativity is to physics. It does not enable one by itself to make new discoveries, just as a compass can not be sufficient for the discovery of land. If, however, you have some idea about the direction in which the new land may lie, using the compass you may unerringly reach this land. So with the relativity theory if a physicist has good intuition, if he knows where he wants to get, then the theory of relativity points the way He will not err if he follows the path shown by the relativity theory It is a most important method which has demonstrated its power in Einstein's work on the theory of gravitation (which is connected with the general theory of relativity) and lately in the development of the new quantum theory.

Beyond the "restricted" theory which refers to uniform motion, I can say only a few words. The possibility of generalizing the relativity theory for any type of motion and making relative not only velocities but also accelerations and so on is, as I mentioned at the beginning, due to the fact that forces of inertia connected with non-uniform motion can not be distinguished from forces of gravity. Suppose that a person is restricted to live all his life in an elevator which is moving up and down How will he register his observations and interpret them? When the elevator starts up you feel heavier and while its ascending motion is being retarded you feel an unusual lightness—as is also the case when the elevator is beginning to descend Its stopping is again accompanied by a sensation of increased weight This change of weight is usually described as apparent, due to the addition or subtraction from the "true" weight the force of inertia which is proportional to the acceleration or retardation. Now a prisoner convicted for life to remain in the elevator and not seeing anything outside the elevator will not admit the idea that the elevator is moving up and down and will identify the apparent weight with the true one and assume that the force of gravity of the earth is being changed, that it acts sometimes with a larger, sometimes with a smaller force.

This fusion of forces of gravity with those of inertia into one single whole is the fundamental idea of Einstein's theory of gravitation and the relativity of all motion as expressed by the general relativity theory. If we assume that motion is relative, then we can consider that the elevator remains at rest and that it is the earth which is moving up and down. This is perfectly natural, though somewhat unusual. We are thinking always that it is the weaker and smaller object that must move, the bigger remaining at rest. It is neither fair not correct from the point of view of the relativity of motion Let us thus consider that the earth is swinging up and down, the elevator remaining at rest. the result is a change in the pull of gravity due to the earth's motion The same thing can be said about a "horizontal" motion, such as that of a car If a car moves very roughly, when starting or stopping you are thrown back and forth, you can say, however, just as well that the car has remained at rest and it is the earth that swayed backward and forward, the gravity force of the moving earth being then directed not downwards, but along an inclined line

Einstein's theory of gravity amounted to formulating the law of gravity in such a way that it would include the forces of inertia and that it would be valid whatever the system of reference chosen (and supposed to be at rest)

The gravitational theory of Einstein is not actually an *explanation* of gravity, it is only a *description* of gravity, but a more correct description than the theory of Newton.

This theory of Einstein has aroused a great deal of misunderstanding I think people are especially struck by things they are unable to understand, and they think these "ununderstandable" things are the most important Einstein's theory of gravity is, I think, associated in everybody's mind with the idea of a "curved" space.

Now what does Einstein mean when he talks about curved space? We must remember that he thinks in mathematical terms, and uses expressions which are misleading to the layman who does not understand the conventional meaning of these words

Suppose you are on a ship and you drop a stone As viewed by you or any other person on board it falls vertically in a straight line. As viewed by some person on the shore, the stone will move in a curved line, namely, a parabola with vertical axis Now this does not mean that the space is curved. It means only that the notion of straightness or curvature is relative in its geometrical aspect. When Einstein talks of space he means actually not space alone but space time, and the curvature attributed to this space-time extension is simply the expression of the fact that there is a lack of uniformity of motion which is due to gravity and which can not be eliminated by a choice of a coordinate system with rectilinear axis. I can not give you the details of that theory, but only an idea of what is actually meant by curvature—it is a kinematical, not statistical or purely geometrical concept.

I can not close without a few words about the retarded propagation of physical forces, which is the corner-stone of relativity, because I have based all my conclusions on this conception, which I not only did not prove but did not explain.

It seems a difficult thing to imagine that forces should be propagated to one body from another through empty space, even if instantly· still more difficult that they are propagated with finite speed, and many people think it is impossible to imagine this and that one must therefore otherwise interpret the facts

The propagation of light with finite velocity was explained 300 years ago by Huyghens in assuming that space was filled with an elastic medium called the luminiferous ether—a very beautiful name and a very helpful idea for the development of physics It is queer, but it is a fact that the main merit of the ether theory has been in helping to achieve a unification of physical phenomena In the nineteenth century Faraday, while studying experimentally electromagnetic phenomena, was biased by the idea that electric and magnetic forces can not be propagated through empty space but only through a material medium, and since it was unreasonable to fill space with another medium, when it was already supposed to be filled with ether it turned out that the ether must transmit not only light vibrations but also electric and magnetic forces This meant obviously, on the one hand, that light was itself an electromagnetic phenomena and, on the other, that electric and magnetic forces must be propagated with a finite velocity equal to that of light This result remained in the later development of physics, although the idea or rather the picture of the ether underlying it was destroyed The theory of the ether had to be abandoned because it led to lots of difficulties There was however a time—in the second half of the nineteenth century—when physicists thought ether the only thing that really existed, and that matter and all other things were simply manifestations of the motion of the ether Lord Kelvin, for instance, set forth a theory according to which atoms were just little vortices in the ether The noted German physicist Drude published in the year 1890 a book on electromagnetic theory which was entitled "The Physics of the Ether."

I should like to write down a translation of a part of an old ode

> O, thou infinite in space
> And eternal in time
> Whom nobody could comprehend,
> Who fills everything, builds up everything, constitutes everything,
> Whom we call—God.

This ode was written by a Russian poet, Desjavin, 120 years ago and was dedicated to God.

You see, however, that this definition of God fully applies to the ether, and the ether actually was the god of physicists of the nineteenth century. This analogy between God and ether as a logical concept is very deep indeed. The development of the ether theory followed precisely the same lines as the development of the idea of divinity. In primitive physics ordinary crude substances forming "ponderable bodies" were distinguished from certain divine bodies, imponderable substances like the caloric, electric and magnetic fluids and finally the ether, which were responsible for all the other properties outside gravity, just as in primitive religion the ordinary mortal beings were opposed to divine or immortal beings. Then in physics we had a gradual fusion of various divine imponderable substances to one divine substance, which was the ether, just as in religion we had a fusion of small deities into one big deity, whose properties are defined in the above ode. In physics the process did not stop here but continued (as by the way it is being continued in religion). It did not stop with the electron theory of Lorentz, where the ether was actually stripped of all its physical properties and reduced to the rôle of Newton's "absolute space remaining at rest." This idea of the ether corresponds to the idea of the perfectly neutral God in modern "deistic" religions.

Finally Einstein threw the ether overboard, and through this "atheistic" act opened the way to the discovery of his relativity theory. In his revolutionary step Einstein was helped very much by Michelson's experiment. In trying to measure the velocity with which light was propagated with respect to the ether, which was supposed to fill all space and which in Lorentz's theory was supposed to be at rest, Michelson found that this velocity remains the same in all directions, irrespective of the alleged motion of the earth through the ether, and this result was the starting-point of Einstein's researches that led to getting physics freed from the ether.

We must not be overthankful to the ether, and keep it in spite of the fact that it is no longer useful. It is rather a nuisance, for it interfered with the development of the true theory. Those who were used to think of physical phenomena in terms of the ether theory, *i. e.*, of the theory that physical actions were propagated through ether, were confronted with extremely difficult problems which could not be solved.

From the point of view of the ether theory, astronomical phenomena pointed to the fact that the earth was moving with respect to the ether while terrestrial experiments pointed to the opposite fact that the ether was dragged along by the earth and physicists were at a loss how to reconcile this contradiction. This problem was, however, a purely fictitious one, like many problems discussed by medieval scholars, for instance, those referring to the properties and behavior of the devil. Some said the devil had a tail, others that he did not. Then there was the issue: if he had a tail he must show it, whereas according to the protagonists of the anti-tail theory it has never been seen. But the representatives of the other point of view retorted that the devil concealed his tail so well that it could not be seen. Exactly in the same way argued the protagonists of the ether.

If Michelson failed to discover motion of the earth through the ether, *i. e.*, the drift of the ether with respect to the earth, then said these people, this meant that the ether produced such a longitudinal contraction in the earth and all the terrestrial bodies that its drift could not be observed.

Einstein was the first to recognize that all these difficulties were fictitious, because the ether, like the devil, was not a real object but a product of human imagination which was helpful for some time in the development of physics but detrimental for further progress of science, and he accordingly threw it overboard.

PHYSIOLOGICAL TIME

By Dr ALEXIS CARREL

ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

PHYSICAL time, which is measured by a clock, obviously differs from the time which we live. Time is as much a constituent of ourselves as space. Body and consciousness are a history. Existence is identical with duration. This inherent time can not be reduced to psychological time, which consists of the succession of our states of consciousness as consecutive instants. According to the Bergsonian view, these states of consciousness are only instantaneous pictures which stand out against a continuously streaming background. But our duration is certainly much more than the flux of our inner life. It comprehends the whole organism. Mind and body are two aspects of a single thing. We are composed of structural and functional, as well as of psychological changes. The time which we live includes both physiological and psychological times. It is measured in hours, days and years, and assumed to flow evenly, inexorably and at the rate of solar time. Such a supposition is convenient, but its truth should be questioned. Even at a superficial glance, physiological time does not seem to pass at a constant rate through the frame of physical time It is a matter of common knowledge that real age differs from chronological age The value of a year is not identical for short-lived and long-lived animals. Moreover, within a single individual such value seems to vary Time is said to flow more quickly in old age than in youth Our duration, then, appears to be independent of physical time It differs from that measured by a clock, because its substratum is physiological and not physical If the motion of the sidereal bodies and of the clocks of the earth were simultaneously retarded or accelerated, physiological time would not vary Each human being constitutes a relatively independent world in a state of continuous transformation It is the rate of this transformation which can be assumed to characterize our specific duration

The living organism undergoes two classes of changes rhythmical and reversible, or progressive and irreversible These changes are as indispensable a part of the body as the tissues and organs described by the anatomists Anatomy, to use a definition of Woodger, studies the organism in timeless space Such a study is imposed by methodological necessity Its object is not the concrete body, but only an artefact An organism deprived of duration is just as unthinkable as if deprived of spatial extension Dead organs and histological sections are nothing but useful abstractions The body really consists of a flux of structural and functional processes, that is, of an uninterrupted modification of tissues, humors and consciousness Such is physiological duration The process of aging starts simultaneously with embryonic life It is expressed by irreversible changes progressing during the entire span of our existence. The decrease in the rate of growth during infancy and youth, the occurrence of puberty and menopause, the lowering of basal metabolism and the modifications of the skin and hair, etc, appear as the stamp of time on the organism Most of these phenomena either occupy a relatively short period of our duration or are not susceptible of sufficiently precise measurement Fortunately, other physiological and chemical processes taking place in tissues or in blood plasma have been found to be measurable during a considerable part of the life span. When small fragments of tissue are removed from an animal and placed in a medium practically deprived of nutrient substances, they manifest some activity and for a few days increase in size. The length of the period of growth and the velocity of the process can easily be ascertained They express the residual growth energy of the tissues In an embryo, this residual energy is greater than in a new-born animal. It continues to decrease during youth But the aging of the organism can not be traced during the whole life by this method because the differences in the growth energy of the tissues of adult and old animals are too small to be accurately detected Moreover, each type of tissue appears to record time in its own way. A more definite effect of time on living structures is observed when one studies the variations of the rate of healing of a wound in function of the age of the patient. As is well known, the progress of the cicatrization of a wound kept in a sterile condition can be calculated by du Nouy's equation This equation contains a constant which depends on the size of the wound and on age After the size of a wound and the constant of cicatrization have been experimentally determined, the age of the patient is easily found A table established by du Nouy shows the corresponding age for a given size of the wound and a given index of cicatrization The human beings used as standards belonged to the same race, were in excellent health and lived under identical conditions Thus, it became possible to ascertain whether an individual is older or younger than his age This method has given us, for the first time, a means of measuring the passing of physiological time Unfortunately, it is not practical because it requires the presence of a wound Moreover, during middle and old age, the differences in the rate of cicatrization become too small to be accurately recorded

These changes in the growth energy of tissues in function of age are obviously related to simultaneous changes of the humors The tissues and organs of the body and the interstitial fluids and blood plasma in which they are immersed constitute a relatively closed world No part of it can undergo any modification without affecting the other parts While the growth energy and the regenerating capacity of tissues decrease, the functional state and the chemical composition of blood plasma show parallel variations These variations are irreversible, progress during the entire life and are measurable Blood serum has been found to possess the property of restraining, under certain conditions, the growth of pure cultures of fibroblasts The ratio of the area of a colony living in serum to that of a similar colony living in saline solution is called the growth index of the serum. The smaller the index, the greater the inhibiting effect of serum The serum of a dog a few days old has no inhibiting effect. Its growth index is equal to unity Soon, it begins to restrain cell multiplication. The growth index decreases very rapidly during the first months of life, more slowly during youth and generally reaches a very small value during maturity. In old age, the variations from year to year are hardly measurable Although such procedure is only roughly approximate, it has brought to light an important phenomenon: the existence of an irreversible change in blood plasma which develops from the beginning to the end of life. It has also rendered possible the expression of duration in units of physiological time, and the measurement of the rate of aging of a given animal during practically its whole existence Should an attempt be made to rejuvenate such an animal, the result of the treatment could be ascertained by the value of the growth index

The inhibiting effect of serum on cell multiplication is due to the presence of proteins and of lipoids The serum proteins of a new-born animal do not restrain the growth of colonies of fibroblasts But their concentration increases as age advances and their nature becomes modified They rapidly acquire their growth-restraining power But it is chiefly to lipoids that the inhibiting property of serum must be attributed These substances increase in quantity and change in quality during life In old age, they are responsible for the toxic effect on tissue cells which serum manifests *in vitro* These alterations in the chemical composition of blood plasma can be considered as causing not only the decrease in the value of the growth index, but probably also that of the index of cicatrization in du Nouy's formula

It is a striking fact that both the index of cicatrization and the growth index of blood serum undergo at the beginning of life a rapid decrease which later becomes slower The curves representing these indexes slope downward very sharply during youth At the end of adult life, they are almost horizontal Therefore, old age may extend over a very long period, when premature senility of some essential organ does not occur. Evidently, the physiological processes responsible for the phenomenon of aging do not advance at an even rate during the whole life. They are far more rapid in infancy than in senescence

Such processes are the substratum of duration. Their characteristics are those of a stream of organic states which ceaselessly blend with one another in the same manner as the states of consciousness constitute our psychological duration. Physiological time is part of the body, while physical time is foreign to it The present of a living organism does not pass into nothingness. It never ceases to be, because it remains in the memory and is entered in the tissues. Bergson has clearly shown how the past persists in the present The body is obviously made up of the past While the present glides into the past, it seems to assume a spatial form. During development, an animal extends simultaneously in time and in space Temporal extension is absolutely indispensable to spatial extension Growth is unthinkable except along one temporal and three spatial axes. In this manner, time is given a spatial representation and considered as a fourth dimension. But such a convenient assumption is probably not accurate. In fact, each spatial dimension also contains temporal elements. At every point of the living things created in space by time, space and time are indissolubly united. Biologists should have conceived long before Einstein and Minkowsky that space and time are not separate entities but constituent elements of a four-dimensional continuum. However, while the organism is evidently located in space time, consciousness can not be completely described within these particular four dimensions.

Physical time flows at a uniform rate. When referred to it, physiological time differs in value from individual to individual, and also from one period to another of the life of a single individual. A unit of physical time may contain larger or smaller amounts of physiological time It is far richer in organic and neurological events during infancy and youth than during adult and old age Our duration does not flow at an even rate.

The passage of physical time is inexorable and irreversible. No one can think of controlling it. Physiological time also moves irresistibly But, owing to the nature of its substratum, it possesses the relative imprecision and variability which characterize biological processes. In recording time, the living organism is far less accurate than an astronomical clock. The rate of its duration may fluctuate. If pathogenic factors happen to modify some of the organs and alter the chemical composition and the physical conditions of the humors, aging becomes accelerated. Physiological time has been found to be not quite inexorable. In lower organisms, its rate can be artificially modified. By drying a rotifer, one may temporarily stop the stream of its duration. On the contrary, when Loeb increased the temperature of the environment of *Drosophila melanogaster,* these flies aged more rapidly. As the organism of the warm-blooded animals is comparatively independent of the outside world, an artificial modification of the processes on which aging depends is a difficult undertaking. However, it would certainly be possible to discover what physiological and psychological disciplines should be offered to human beings in order to increase the span of their life. On the contrary, the problem of rejuvenation, if this word is taken with its full significance, appears to be insoluble. The reversion of physiological time would require a method capable of replacing tissues and humors in the structural and functional state of an earlier life period. Such a method has still to be discovered. It goes without saying that no senescent organism has ever been rejuvenated by the procedures of Steinach and Voronoff. So far, the process of aging remains irreversible.

Physiological duration depends entirely on the presence in the universe of organized living matter. It appears as soon as a portion of space containing metabolizing things becomes relatively isolated from the surrounding world. At all levels of organization, in the body of a minute cell as well as in that of an elephant, the cause of duration seems to consist of the modification of their medium produced by living structures, and of the secondary changes undergone by these structures under the influence of the modified medium. Time is recorded by a cell community only when the metabolic products are allowed to remain around the tissue. The simplest artificial system which shows the phenomenon of aging consists of a colony of tissue or blood cells living in a medium limited in quantity. In such a system, the medium is progressively altered by the products of cell activity and, in its turn, reacts on the cells. Then aging and death take place. The rate of aging of a given colony depends on its size and metabolic activity, and on the volume and composition of the medium. The fate of a tissue differs profoundly according to whether it lives in a small drop of plasma in the limited atmosphere of a hollow slide, or in a flask containing a large quantity of plasma and gases. It is the accumulation of metabolites in the medium which determines the duration of the system cells-environment. If these metabolites are removed at short intervals and the composition of the medium is kept constant, the cell colonies remain indefinitely in a same state of activity. They do not record time qualitatively. In fact, they are immortal. In the simple systems which we have so far considered, the existence of the process of aging must be attributed to the capacity of the environment to be permanently altered by tissue metabolism.

The relations of the tissues and organs to their environment are infinitely more complex in the higher animals than in these artificial systems. Although lymph and blood plasma which constitute the *milieu intérieur*, to use an expression of Claude Bernard, are continuously modified by metabolic products, they maintain a nearly constant composition, owing to the work of the lungs, kidneys, liver, intestines, etc. However, in spite of such an elaborate regulatory mechanism, slow changes, as stated above, take place in the composition of plasma and, under the influence of these changes, the tissues themselves become modified. Such phenomena are bound to a certain constitution of the organism. The fact of duration necessarily depends on the nature and mode of association of the metabolizing elements of the body and of the *milieu intérieur*.

We may conclude that physiological time is a succession of irreversible changes of the system cells-medium; that it can be measured by the rate of these changes and expressed in special units, and that the fundamental constituents of duration are structural and physiological processes bound to a certain type of organization, and specific of each species, of each individual and of the age of each individual. As living organisms are immersed in the physical universe, their duration must either be placed in the frame of physical time or be used as a frame for physical time. In fact, physical time is referred to physiological duration. Then, an important phenomenon takes place: physical time loses its constant value. It extends during infancy, and contracts during old age. Let us suppose two trains starting with the same speed and running on parallel tracks. The first train represents physical time and moves at a constant speed. The second train, on which we travel, represents physiological time and moves at a decreasing speed. At the beginning, the first train remains immobile, because we run as fast as it does. Later, as we advance less rapidly, its speed increases. Finally, when in maturity and old age we slow down, the train symbolizing physical time acquires great velocity and flies away. In the same manner, one year is far longer for a child than for his parents. Young and old people, although spatially united, live in separate universes where the value of physical time profoundly differs. It does not appear that educators and psychologists have as yet realized the importance of the unequal temporal value of the successive periods of life. Although these inequalities are clearly shown only by the measurement of physiological duration, it is certain that they are also a datum of consciousness. During youth, one year seems to be very long, and in old age, very short. Both psychological and physiological times flow in the same direction. But their reciprocal relations remain as mysterious as those of consciousness and cerebrum. Physiological time has the advantage over psychological time of being measurable. Hence, a more complete knowledge of its nature can easily be acquired. Such a knowledge is indispensable to a real understanding of the constitution of the body, which is composed not only of organs, bones, lymph and blood, but also of duration.

OBITUARY

MEMORIALS

The Journal of the American Medical Association reports that a medical and surgical building was completed at the Johns Hopkins Hospital, on November 6, giving the institution a capacity of about 1,000 beds. Half of the building, the Osler Clinic, was completed and occupied in January, the other half is the Halsted Clinic These clinics are memorials to the late Dr William S Halsted, first professor of surgery, and the late Sir William Osler, first professor of medicine, at the Johns Hopkins University School of Medicine The addition, which provides about 300 beds, will house only ward patients The building cost $1,740,000, provided by a gift of $500,000 from the General Education Board and an appropriation from an anonymous gift of $3,000,000

To honor the memory of a late leader in the field of x-ray work in medicine, a bronze plaque in bas-relief of Dr Preston M Hickey, for many years director of the department of roentgenology at the University of Michigan Hospital, will be presented to the university by the American Roentgen Ray Society The plaque is the work of Mr Heinz Peter and the presentation will be made by Dr Leopold Jaches, of New York City, president of the society

AN oil portrait, painted by William Wirtz, of the late Dean Edward Vernon Howell, of the School of Pharmacy of the University of North Carolina, has been given to the school by Mr J Edward Murray, vice-president of the Emerson Drug Company of Baltimore

A PORTRAIT of the late Edward Mallinckrodt was recently unveiled at the Mallinckrodt Institute of Radiology at St Louis Mr Charles Nagel and Dr Evarts Graham were the principal speakers

A MARBLE bust of Thomas Alva Edison, presented by the principal associations of electrical engineers in the United States, has been placed in the Hall of Electrical Engineering in the German Museum (Deutsches Museum) in Munich, next to a bust of Werner von Siemens Edison was a member of the committee of the museum Edison exhibits at the museum include pictures and blue prints, original models and exact reproductions covering many of Edison's inventions in the sphere of electricity, as well as several exhibits in connection with some of the other fields of physical science in which he worked

ACCORDING to the *Journal* of the American Medical Association the British Medical Association has opened a fund to establish a memorial to its founder, Sir Charles Hastings, in celebration of its centenary, which occurs in 1932 A stained glass window in his honor will be placed in the cathedral at Worcester, the city with which Hastings was most closely identified, a tablet will be placed on the house in Worcester where he practiced, and his grave in the Astwood Cemetery in that city will be restored and cared for. Any balance remaining after these objects have been attained will be turned over to the Sir Charles Hastings Fund, the income of which is distributed for the benefit of members of the medical profession and their dependents according to the discretion of its trustees The opening ceremony of the centenary meeting of the association will be a pilgrimage to Worcester, July 24, 1932, when the memorial window and plaque will be unveiled

ACCORDING to *Nature* the Polish Physical Society, the Polish Chemical Society, and the Society of Polish Electrical Engineers, with the support and assistance of the Polish Academy of Sciences, Cracow, the Polish Academy of Technology, the scientific societies of Warsaw and Lwow, and various other Polish scientific institutions, arranged for a celebration of the Faraday centenary, on November 6, at Warsaw, in the large hall of the Technical High School The president of the Polish Republic, Professor Moscicki, and three members of the government were present, the British Embassy was also represented After a short introductory speech, made by Professor St Pieńkowski, Dr Ladislas Natanson, professor of natural philosophy in the Jagellonian University, Cracow, delivered a lecture on the "Life and Discoveries of Michael Faraday" Addresses were also delivered by Professor W Swietoslawski, of the Warsaw Technical High School, who discussed and explained Faraday's chemical and electrochemical researches, and Mr T Czaplicki, who chose for his subject, "Faraday and the Modern Science of Applied Electricity." The proceedings concluded with an exhibition of pictures connected with Faraday's life and work.

RECENT DEATHS

DR CLARENCE L E MOORE, professor of mathematics at the Massachusetts Institute of Technology, died on December 5, at the age of fifty-five years

PROFESSOR GEORGE HERBERT LAMSON, JR, dean of the division of Arts and Sciences in Connecticut Agricultural College, at Storrs, died suddenly on December 4

PROFESSOR CARVETH READ, professor emeritus of philosophy and comparative psychology at the University of London, died on December 8 at the age of eighty-three years

SCIENTIFIC EVENTS

THE WELLCOME RESEARCH INSTITUTION

LORD MOYNIHAN, president of the British Royal College of Surgeons, on November 25 laid the corner-stone of the new buildings for the Wellcome Research Institution which are to occupy the frontage upon Euston Road immediately north of University College.

According to the London *Times* the new buildings, which are already more than half-way to completion, cover the greater part of a block bounded on the east by Gordon Street and on the south by Gower Place, and adjoin the headquarters of the National Union of Railwaymen Part of the site available was occupied until the present year by the Wellcome Museum of Medical Science and the Wellcome Bureau of Scientific Research, which were established before the war and enlarged and reopened in 1926 The building then existing has been pulled down, and the bodies concerned transferred to other quarters until the new research institution building is completed this spring, when they will be extended over the old site

It is intended to maintain the Wellcome Museum of Medical Science, with its special exhibits covering tropical medicine and hygiene, upon the ground floor of the new building, with administrative offices, storerooms and lecture-rooms on the basement floors University classes have made constant use of the old museum, together with many general practitioners and consultants, and the extension has been made principally to enable the teaching facilities of the museum and the Wellcome Bureau of Scientific Research, which it serves, to be extended The floors above the third story will be utilized principally for laboratories, and it is expected that the accommodation offered hitherto by twelve laboratories to students of medical zoology, parasitology, bacteriology and chemotherapy will be roughly doubled Physiological and entomological laboratories will be established in the new building, though the Entomological Field Laboratory at Claremont, Esher and the Physiological Research Laboratories at Beckenham will continue undisturbed

The three floors of the new building immediately above the ground floor and below the new laboratories will be given over to the Wellcome Historical Medical Museum, which will be entirely transferred from its present premises in Wigmore Street next year. While room has been found in Wigmore Street to exhibit such memorial collections as those of Jenner and Lister, and galleries have been devoted to primitive medicine and surgery, and to the folk-lore and anthropological collections associated with them, there has hitherto been insufficient space to show either the links between individual modern pioneers or more than a tenth of the primitive collections.

At the ceremony a bronze casket containing the historical records of the Wellcome Research Laboratories and Museums was inserted in the corner-stone by Dr. Wellcome and Mr. George E. Pearson, and the stone was laid by Lord Moynihan with a silver trowel presented by the architect, Mr. Septimus Warwick.

In his address, Lord Moynihan paid tribute to the forty years' work of Dr Wellcome in promoting medical research

NEW BIRD SANCTUARIES

The Migratory Bird Conservation Commission, of which Secretary Hyde, of the Department of Agriculture, is chairman, authorized on December 3 the acquisition of lands by the Bureau of Biological Survey for ten migratory game-bird refuges in New York, Maryland, North Carolina, South Carolina, Florida, Nebraska, North Dakota, Wyoming and Nevada. The area amounts to 43,227 acres The cost to the government will average $5 74 an acre

Including the lands approved by the commission, 154,744 acres have been authorized for acquisition by lease and by purchase since the migratory-bird refuge program was initiated in 1930 In addition 65,970 acres have been set aside by executive order and presidential proclamation, making a total of 220,713 acres established or in the process of being established as inviolate federal sanctuaries for migratory birds Refuges have been established in California, Nevada, Montana, Wyoming, North Dakota, Nebraska, Oklahoma, Florida, South Carolina, North Carolina, Maryland and New York The average cost per acre of all lands approved for purchase under the act is $4 30

In New York the commission authorized the leasing of lands for the Hempstead Migratory Bird Refuge, an area of 2,274 acres of land and water adjacent to Howlett, Long Island Because it is on the Atlantic coast flight route of migratory birds and near to the metropolitan area of New York this is considered an important link in the eastern chain of refuges

An important acquisition is the Blackwater Migratory Bird Refuge on the eastern shore of Maryland. This unit, situated about 10 miles from Cambridge, Maryland, contains approximately 10,000 acres, including marshes where black ducks and blue-winged teal breed in greater numbers than on any other area on the eastern seaboard south of Labrador Mallards and pintails also concentrate on the marshes during the migration season

In the Swanquarter Migratory Bird Refuge in Hyde County, North Carolina, acquisition of 3,600 acres contiguous to tracts previously approved was authorized. With the water areas this tract borders, the refuge will now make an administrative unit of about 25,000 acres

Acquisition in South Carolina of approximately 414 acres of land will complete consolidation of government-owned land in the Cape Romain Refuge The total area in this unit is now about 33,000 acres.

The acquisition of 5,285 acres for the St. Marks Refuge, Florida, will consolidate the government holdings there With nearly 14,000 acres approved for acquisition a year ago this brings the total area in the process of acquisition to 19,167 acres.

Crescent Lake Migratory Bird Refuge, Nebraska, will be extended by the acquisition of 1,688 acres, including several extensive water areas and numerous ponds and potholes The acquisition will also tend to round out the boundaries of this sanctuary, which now includes about 40,000 acres.

By approving the acquisition of numerous small tracts bordering on Long Lake, in Kidder and Burleigh Counties, North Dakota, the commission took steps looking to the establishment of the first federal migratory-bird refuge in that state The total area approved Dec 3 for acquisition there is 4,269 acres

The acquisition of 3,465 acres in Wyoming is the first to be approved for that state Two refuges about 12 miles apart, one at Bamforth Lake and the other at Hutton Lake, both near Laramie, will be acquired

The lands being acquired in Nevada will be additions to the 17,902 acres of the Fallon Migratory Bird Refuge set aside from the public domain by executive order in February, 1931, as a sanctuary for migratory birds The total area will now be 31,288 acres.

THE SEVENTH AMERICAN SCIENTIFIC CONGRESS

THE seventh American Scientific Congress will be held in Mexico City from February 5 to 19, 1932, under the presidency of Dr Alfonso Prunada, rector of the National University

In addition to the opening and closing ceremonies and such other general sessions as may be arranged, the congress will meet in the following twelve sections Physical and Mathematical Sciences, General and Applied Geology, Engineering, Industrial Chemistry, Biology, Scientific Agriculture, Medicine, Hygiene and Public Health, Anthropological and Historical Sciences, Juridical Sciences, Social and Economic Sciences and Education.

The official languages of the congress will be: Spanish, French, English and Portuguese. The papers presented to the congress may touch on all matters of scientific interest, as set forth under the headings of the different sections, and may treat the subjects from the point of view of pure science or from that of applied science. Abstracts should be sent to the general secretary, Dr Pedro de Alba, at an early date, in order that they may be put in type for distribution at the meeting.

The following statement in regard to the history of the congress has been made by the organizing committee:

> In 1896, and in order to commemorate the twenty-fifth anniversary of its foundation, the Scientific Association of the Argentine Republic invited the countries of Latin-America to a Latin-American Scientific Congress, which was held in Buenos Aires from the 10th to the 21st of April, 1898 Following upon this assembly, the second and third of these congresses were held in Montevideo and in Rio de Janeiro, respectively, in 1901 and 1905.
>
> The fourth Latin-American Scientific Congress was held in Santiago de Chile in December, 1908, and owing to a resolution adopted by the Chilean Government, the congress was named First Pan American Scientific Congress The second and third congresses under this new denomination were held, respectively, in Washington (1919) and in Lima (December, 1924, to January, 1925)
>
> The congress assembled in Lima determined that the next congress be known as the Seventh American Scientific Congress and appointed San Jose de Costa Rica as the city where it was to be held, owing, however, to various circumstances, the congress could not be held in that city, and accordingly the Board of Directors of the Pan-American Union (formed by the diplomatic representatives of the various nations in Washington) consulted the Mexican Government as to the advisability of holding the congress in Mexico City. The Mexican Government, after consulting the case with the Ministry of Public Education, expressed its approval of the proposal, and thus it was determined that the assembly be held in the City of Mexico in February, 1932

The organizing committee extends a cordial invitation to all scientific men of America to attend the congress and to take part in its labors. "The sessions will promote the knowledge of the progress made in the various countries of the continent, in order to study and discuss some of the outstanding problems of those nations and will help to set up closer bonds of lasting friendship between the various countries. Mexico awaits enthusiastically the visit of those who will be its guests for a few days, during which both the authorities and the organizing committee will spare no effort to make their stay in the country as agreeable as possible in every way."

All correspondence with reference to the congress should be addressed to: Comision Organizadora Del Septimo Congreso Cientifico Americano, Apartado Postal 517, Mexico, D F.

AWARD OF THE EDISON MEDAL TO DR. EDWIN W. RICE, JR.

THE Edison Medal for 1931 has been awarded by the American Institute of Electrical Engineers to Dr. Edwin Wilbur Rice, Jr., "for his contributions to the development of electrical systems and apparatus and his encouragement of scientific research in industry."

The Edison Medal was founded by associates and friends of Thomas A. Edison, and is awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by a committee consisting of twenty-four members of the American Institute of Electrical Engineers.

The following eminent engineers and scientists have been recipients of the medal. Elihu Thomson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush, Alexander Graham Bell, Nikola Tesla, John J. Carty, Benjamin G Lamme, W L R Emmet, Michael I. Pupin, Cummings C Chesney, Robert A. Millikan, John W. Lieb, John White Howell, Harris J. Ryan, William D Coolidge, Frank B. Jewett, Charles F. Scott and Frank Conrad

Dr. Rice is one of the pioneers of electrical development in the United States and has played a conspicuous part, in association with the late Charles A Coffin, in the building of the General Electric Company

As a school-boy in Philadelphia he came in contact in 1876 with Professor Elihu Thomson, then a young teacher in the Boys' Central High School His natural fondness for mechanics and later for electricity was quickly developed by this association, and when in 1880 Dr Thomson gave up teaching to go into electrical manufacturing as investigator and inventor, Rice became his assistant.

He went with Dr Thomson to New Britain, Connecticut, in the old American Electric Company, and in 1883 went with him to Lynn, Massachusetts, when the Thomson-Houston Electric Company was organized. At the age of twenty-two years he was made plant superintendent and had full responsibility until the consolidation of the Thomson-Houston Electric Company and the Edison General Electric Company in 1892, under the name of General Electric Company.

In the new company Mr Rice was first made technical director, then vice-president in charge of manufacturing and engineering. He eventually became senior vice-president, and in 1913 he succeeded Mr. Coffin as president of the company In 1922, after nine years' service in that office, Dr Rice was succeeded by Mr. Gerard Swope and Dr Rice was made honorary chairman of the board, which position he still holds.

Dr. Rice has contributed much through organization methods, improved factory routine, technical development, and engineering and scientific inventions. He invented the present fundamental form of high-voltage oil switch and the cellular system of separating fuses and circuits, as well as the application of synchronous converters to the building of unified alternating and direct-current distribution systems. He was responsible for the establishment of the General Electric research laboratory

SCIENTIFIC NOTES AND NEWS

The first session of the council of the American Association for the Advancement of Science at New Orleans will be held in the Gold Room, Roosevelt Hotel, at 2 00 o'clock on Monday afternoon, December 28. It is hoped that a large attendance of council members will be present, as important matters are to be considered. Later sessions of the council will occur at 9.00 on the mornings of Tuesday, Wednesday, Thursday and Friday, December 29, 30, 31 and January 1. These sessions are to be adjourned in time for council members to attend the scientific sessions that begin at 10.00 o'clock

Dr. Frederick V Coville, principal botanist in charge of the division of botany of the Bureau of Plant Industry; acting director of the National Arboretum, curator of the United States National Herbarium at the Smithsonian Institution, and chairman of the research committee of the National Geographic Society, recently was awarded the George Robert White Gold Medal of Honor by the Massachusetts Horticultural Society for distinction in botanical fields.

The Henry S Wellcome Medal and Prize of $500 have been awarded to Colonel George A. Skinner, chief surgeon, seventh corps area, U S. Army, Omaha, for a paper on "The Influence of Epidemic Disease on Military Operations in the Western Hemisphere" The Wellcome award was established in 1916 to encourage study and research on problems connected with the health of armies and the efficiency of the medical services

Professor Kalman J. DeJuhasz, of the Pennsylvania State College, was presented with the Rudolph Diesel Award at the recent annual meeting of the American Society of Mechanical Engineers The award was made for a paper on Diesel engine operation entitled "Dispersion of Sprays in Solid Injection Oil Engines"

The Institution of Civil Engineers, London, has awarded the Indian Premium for the session 1930–31 to Mr G C Minnitt, Bombay, for a paper read and discussed at an ordinary meeting of the institution They have also made the following awards in respect of "Selected Engineering Papers" published without discussion: A Telford gold medal to Mr. Herbert Addison, Giza, Egypt, Telford premiums to Messrs. H. A Sieveking, London; William Blackadder, Aberdeen; R. F. Legget, Montreal, and jointly to Messrs R. G. C. Batson and H. R. Mills, Teddington.

The Buckston Browne Prize and Medals of the Harveian Society of London have been awarded to Mr. Cecil P. G Wakeley and Mr. Laurence O'Shaughnessy, whose essays on "The Treatment of Shock by Intravenous Therapy" were deemed to be of equal merit

Nature reports that at a general meeting of the French Society of Electrical Engineering on November 7, it was decided to confer the title of honorary member on Mr Percy F Rowell, secretary of the Institution of Electrical Engineers, in recognition of his work in establishing close collaboration between the French society and the Institution of Electrical Engineers, particularly during the Anglo-French Congress held in Paris in 1913, the meeting of the institution held in France in 1929, and the Faraday celebrations held in London in 1931

THE degree of LL D has been conferred by the University of Manchester on Professor F E Weiss, formerly Harrison professor of botany, on his retirement from active service and in recognition of his long and distinguished membership of the teaching staff

DR. SVEN HEDIN, of Stockholm, the explorer, has had an honorary doctorate conferred on him by the Berlin Institute of Commerce

DR HANS MOLISCH, professor of the anatomy and physiology of plants at the University of Vienna, celebrated his seventy-fifth birthday on December 6

PROFESSOR DOUGLAS JOHNSON, of Columbia University, has been elected to honorary life membership in the National Geographic Society in recognition of his "contributions for the increase and diffusion of geographic knowledge"

DR A. RICHARD BLISS, JR, chief of the division of pharmacology, College of Medicine, University of Tennessee, was elected president of the Tennessee Academy of Science at the annual meeting at Nashville on November 28

AT the thirty-fourth annual meeting on December 10 of the Massachusetts Forestry Association, Mr Harvey N Shepard, of Boston, was elected president

AT the anniversary meeting of the Mineralogical Society, London, Sir John S Flett was elected president The vice-presidents are Dr G F Herbert Smith and Professor C Gilbert Cullis

DR. WILLIAM S LADD, formerly on the faculty of the College of Physicians and Surgeons, Columbia University, has been appointed assistant professor of medicine and associate dean of Cornell University Medical College.

IT is announced in *Nature* that Dr J Ward, senior lecturer in mechanical engineering at the Northampton Polytechnic Institute, London, has been appointed head of the department of civil and mechanical engineering at the Technical College, Huddersfield, in succession to Mr J W Button, who is about to retire after twenty-four years' service as head of the department

AT the University of London, Mr F W Twort, F R S, of the Brown Animal Sanatory Institution, has been promoted to a professorship of bacteriology, and Dr H A Harris, University College and University College Hospital, to a professorship of clinical anatomy

DR JOHN HAROLD ANDREW, professor of metallurgy at the Royal Technical College, Glasgow, has been appointed to the chair of metallurgy at the University of Sheffield

THE first Arthur lecture of the Smithsonian Institution, endowed by the late James Arthur, to promote study of the sun, will be given on January 25 by Dr Henry Norris Russell, of Princeton University, on "The Composition of the Sun" In March Dr Aleš Hrdlička, of the National Museum, will lecture on his recent archeological explorations in Alaska dealing with the coming of man from Asia to North America.

DR FREDERICK H SEARES, assistant director, Mount Wilson Observatory, Carnegie Institution of Washington, gave on December 8, before the Carnegie Institution of Washington, an illustrated lecture on "The Stars about Us"

DR G E COGHILL, of the Wistar Institute of Anatomy and Biology, Philadelphia, delivered an address before the Royal Canadian Institute on November 28 on "Reflex Action in Development and Behavior"

THE Frazer Lecture in social anthropology was delivered at the University of Cambridge on November 26 by Sir Arthur Evans on "Some Aspects of the Earlier Religion of Greece in the Light of Cretan Discovery"

THE forty-seventh meeting of the American Astronomical Society will be held in Washington, D. C., from December 28 to 30

THE one hundred and seventy-fourth regular meeting of the American Physical Society will be held in Le Conte Hall, University of California, on December 18 and 19 Unless it is necessary to continue the scientific sessions, Saturday afternoon will be spent in tours of inspection of the department of physics of the university for those members who wish to see the researches in progress

THE third International Congress of Eugenics will be held under the auspices of the International Federation of Eugenic Organizations The scientific papers and the social features of the congress will be centered at the American Museum of Natural History in New York City and at the Eugenics Record Office in Cold Spring Harbor, from Sunday, August 21 to Wednesday, August 24, 1932 Following the congress many members of the congress, particularly those interested primarily in genetics, will go to Ithaca, N Y, where the Sixth International Congress of Genetics will be held from August 24 to 31 On Monday, August 22, the Eugenics Exhibit will open in New York, closing on September 22 Members of the Exhibits Committee are William K Gregory, Frederick Osborn, George H Sherwood, Clark Wissler and Harry H Laughlin, *chairman* It is the purpose of this exhibit to show the history, content, present researches and trends of eugenics, both as a pure and an applied science It will seek to emphasize the fact that eugenics is concerned primarily with racial and family-stock quality in the turnover of population from generation to generation

THE ninth International Congress of the History of Medicine will be held in Bucharest in September, 1932 The principal subjects for discussion will be the evolution of medicine in the Balkan states and the protection of Europe against bubonic plague Those wishing to contribute papers are requested to forward the title and a summary of the paper to the office of the congress, Str Stirbey Voda, 86, Bucharest II

ACCORDING to *Nature* the British Institute of Radiology, incorporated with the Rontgen Society, held its annual conference from December 2 to 4 With the conference there was an exhibition of apparatus, organized by the Associated Manufacturers The conference was opened by the Right Honorable Lord Rutherford, and Dr A E Barclay delivered the presidential address Besides several technical papers there were two lectures the fourteenth Silvanus Thompson Memorial Lecture by Sir James Jeans, on radiation, and the twelfth Mackenzie Davidson Memorial Lecture by Professor Dr Hans Holfelder, on medical, surgical and radiological treatments of disease Cinematograph films illustrating experiments on the inflammability of films (Prof F Haenisch) and the effects of radium on living cultivated tissues (Dr R G Canti) were exhibited

PUBLIC lectures will be given beginning with January 9 on Saturday afternoons at 3 30 at the New York Botanical Garden during January and February. The subjects and speakers are as follows "Outdoor and Indoor Ferns," Dr. Ralph C Benedict, Brooklyn Botanic Garden. "Planting and Growing Conifers," Mr. Alexander Michie, nursery manager for T. A Havemeyer. "Roses," Dr. B O. Dodge, plant pathologist. "Begonias," Mr. T H Everett, head gardener at the Manville Estate, Pleasantville. "Flowering Shrubs," Mr J H. Beale, Boyce Thompson Institute, Yonkers. "Annuals," Mr. Kenneth R Boynton, head gardener "Water Lilies and Their Care," Mr H W Becker, in charge of greenhouses "Dahlias and Chrysanthemums," Dr M. A Howe, assistant director, and Mr Kenneth R Boynton, head gardener

THE London *Times* reports that Christmas scientific lectures and experiments for children have been arranged by various institutions in London as follows Professor E N da Costa Andrade, Quain professor of physics at London University, will give the Royal Society of Arts lectures in the afternoons of January 6 and 13 His subject will be "The Vacuum, or the Importance of Nothing at All" Sir William Bragg will lecture at the Royal Institution on December 29 and 31 and January 2, 5, 7 and 9 His subject will be "The Universe of Light" At the Royal Geographical Society will be given lectures on January 4 and 8 The first lecture will be by the President, Admiral Sir William Goodenough, who will speak on "South and East" The second, "Through Lapland in Winter with Sledge and Reindeer," will be given by Mrs Murray Chapman Mr E R Jarrett will deliver the Royal Institute of British Architects' lectures on December 28 and 30 and January 1 Special films will be shown at the Imperial Institute cinema

ONE of the most valuable private zoological collections in existence, numbering 30,000 skins and many thousand birds and eggs, including the rarest North American specimens, has been given to the Harvard Museum of Comparative Zoology by Mr John E Thayer, ornithologist, of Lancaster, Massachusetts, a graduate of Harvard University in the class of 1885. The collection was assembled at great cost and labor Expeditions were sent by Mr Thayer to Alaska, northeastern Siberia, the Queen Charlotte Island, Lower California and Northern Mexico The gift also included ten eggs of the great auk. Harvard now has eleven auk eggs, or about one sixth of all known existing specimens

THE Carnegie Corporation of New York has made a grant of \$30,000 to the British Museums Association for the survey of the museums of the British Empire outside the British Isles.

ACCORDING to the *Journal* of the American Medical Association, the Laboratory of Marine Biology was recently dedicated at Rovigno, Istria The origin of the institute dates back to a zoological station established at Rovigno by Germany in 1891. A recent agreement entered into by the governments of Italy and Germany provides that the institute shall be regarded as the joint property of the two countries, which will share equally the current expense of its administration and will have an equal number of persons on its staff Professor Sella has been appointed codirector for Italy and Professor Stener for Germany The institute has important collections of fish, mollusks and crustaceans Researches have been made on ocean depths, ocean currents and water pressure at various ocean depths.

THE London *Times* states that the Governors-General of Algeria and of French West Africa have organized a scientific expedition across the Sahara to Central Africa M A. Chevalier, professor of applied botany at the French National Museum of Natural History, who has spent many years in studying agriculture and vegetation in the French colonies, heads the expedition. The expedition will visit the oases of Southern Algeria—which is part of the Sahara—to study the vegetation and see if new plants and trees can be introduced For this purpose slips and cuttings from the best Biskra date palms, notably the "deglet-nour" (Finger of Light) variety, are being taken by the expedition At Reggan, in the heart of the Sahara, a permanent experimental botanical garden will be established. From Niamey, on the Niger, the expedition will go towards Air and Lake Chad, across country where for the most part the vegetation will be scientifically studied for the first time, to get museum specimens Here, too, the expedition will carry out important investigations into the laying and breeding places of the African locust The expedition will return to France by way of the French Sudan and Senegal, in which region it will study the local methods of growing cotton, sisal, groundnuts and native cereals.

ACCORDING to the London *Times* the second annual report of the Executive Council of the Imperial Agricultural Bureaus states that there are now eight bureaus controlled by the council, on which all the Dominions are represented The funds are provided jointly by the Dominions, the colonies and the home country During the year, 1930–31, reviewed the council continued to receive the full support of all contributing countries, in spite of acute financial difficulties in many of those countries The bureaus act as clearing-houses of information in the field of agricultural science and keep Empire research workers in touch with each other and with the latest scientific advances in other countries. During 1930–31 contacts were established with research workers all over the Empire. Over 2,000 names are now on the mailing list to receive the publications of the various bureaus, each of which is established at a leading research station in this country. Three special conferences were organized by the bureaus, and they dealt with soil science, animal health and fruit production. These conferences were well attended by research workers both in the United Kingdom and in the Empire oversea, and at all of them technical questions were discussed as well as the work of the bureaus. Several officers attached to the bureaus have toured one or more of the Dominions to establish personal contact with research workers. Three of the bureaus —those dealing with animal genetics at Edinburgh, plant genetics at Aberystwyth and animal health at Weybridge—now issue regular journals containing abstracts of new and important research papers and bibliographies of publications, in foreign as well as in Empire countries. The report records a resolution adopted by the Imperial Conference, 1930, declaring that the bureaus provide "both a notable precedent for action on a true Commonwealth basis and a contribution that is already bearing fruit in the better dissemination of scientific knowledge throughout the Empire"

The Museums Journal reports that the South African Parliament has established two new game reserves one in northwestern South Africa between the Aub and Nossob Rivers will provide sanctuary for gemsbock or oryx, kudu, eland, gnu, lions, leopards and rare birds; the other in the eastern part of the Union, the Addo reserve, is the last refuge of a few South African elephants The new reserves are administered by the National Park Department.

FOR the purpose of conducting further tests in the field of radio wave propagation, the University of Washington has placed both the personnel and apparatus of its Scientific Research and General Engineering Departments at the disposal of the National Park Service, according to an announcement made by Dr Ray Lyman Wilbur, Secretary of the Interior Experiments with radio as a means of communication in national parks have been in progress in Mount Rainier National Park in the State of Washington for some time and have demonstrated a sufficient limited use of radio as a means of communication in primitive areas such as the mountainous parks, especially in forest-fire emergencies and interrupted telephone communication caused by storms, to justify further experiments. Mount Rainier now has the first system of radio communication ever to be established in a national park. Late in the summer call letters for six stationary and four portable stations were assigned to Mount Rainier by the Department of Commerce. The university is now building a radio station to aid in this work. Two of the permanent stations in Mount Rainier Park are at Longmire, and the others at Paradise, Sunrise and the White River and Carbon River entrances to the park. These stations have a ten-tube combination modulated by four tubes for voice and six tubes for code. The portable sets, which will, of course, be carried by rangers on patrol, will prove especially effective in emergencies.

DISCUSSION

A SUBMERGED BEACH OFF BERMUDA

Work has been continuous this summer on the Third Bermuda Oceanographic Expedition This is carried on as before, under the directorship of the writer, by the Department of Tropical Research of the New York Zoological Society

In the course of the researches on the limited deep-sea area under intensive study, some interesting new discoveries have come to light and one in particular The area covered in the season of 1931 was, as before, roughly a circle eight miles in diameter, with its center 32° 12′ North Latitude and 64° 36′ West Longitude, which point is 160 degrees by the compass, or south-south-east of Nonsuch Island, Bermuda This brings the center of the circle 6 75 miles from the nearest one hundred fathom line and 9 25 miles from the laboratory on Nonsuch

In addition to the regular trawling, attention has been given this season to temperatures and water samples, and work on the bottom. Accidental touching of the bottom from time to time by the silk nets has shown that this lies within the small area of pteropod ooze which was discovered many years ago south of and close to Bermuda These nets were usually torn, and a large otter trawl which I lowered one thousand fathoms to the bottom was ripped half across.

Four-foot iron dredges were used this year with unexpected results About two hauls were made with each dredge before it was lost, and at each successful haul the dredge was bent almost double. One-half square-inch mesh netting was used on the dredge, which allowed most of the pteropod ooze to slip through What remained was of great interest, since it consisted almost entirely of water-worn pebbles, shells and bits of coral Several hauls were made at nine miles distance from shore, and later others at twelve miles yielded the same general material

The lowest levels of oceanic water at the glacial periods have permitted to geologists estimates of an increased Bermudian land area from almost twenty square miles of the present dry land, to 230 square miles, including all the shallow waters to the outermost reefs. An actual rise and subsidence of the land itself is admitted, a change in altitude, however, not exceeding 150 feet.

The gradient of the sea bottom south and south-east of Nonsuch, out to nine miles, is, to judge by my soundings and those marked on admiralty charts, about one in six.

The depths at which my dredge hauls were made, where absolute evidence of submerged sea beaches was brought up, were 1,450 to 1,550 fathoms, over one and a half miles deep This was in perfect conformity with the proven roughness of the bottom over almost all the area in the eight-mile circle The sea-floor at 1,000 to 1,500 fathoms is usually comparatively smooth and flat But here my nets and dredges have encountered obstacles at every trawl, obstacles similar in hardness, and in the bits of broken rocks which came up, to the water and air-worn reef rocks in shallow water near the shore

I have submitted my shells to Mr Arthur Haycock, who has kindly identified them, and Dr C M Yonge, of the Marine Biological Association, while on a recent visit to Nonsuch, was good enough to look over the alcyonarians and corals

I have had no opportunity to extend the dredgings beyond my eight-mile circle, but, at the most conservative estimate, the addition to a former Bermudian land mass is more than sixty times In other words, the present dry land of Bermuda is slightly less than the area of Manhattan Island (19 3, as compared with 22 square miles), while the area added by the inclusion seaward of these submerged beaches would increase this to 576 square miles This is only an estimate, but, based on these preliminary facts, it is probably far under the truth

A complete report will be forthcoming. Here it will suffice to say that the majority of the waterworn bivalves are *Glycimeris* and *Pectunculus,* nearly fifty of which were taken in Dredge No 1224, at 1,500 fathoms With these were *Arca imbricata,* a *Cardium, Cryptodon chrisostoma, Ostrea frons, Chione latilirata,* etc Also bits of limestone affected by volcanic action The pteropods remaining in the coarse dredge nets were chiefly *Cavolinia* and *Cuvierina*

Some of these shells have been found fossil in Bermuda by Mr Haycock, together with similar water-worn pebbles in old raised beaches thirty feet above high water, and most of them are West Indian species.

The bottom of my trawling area appears to alternate tall, exposed, reef-like, sharp-edged, water-worn limestone, with stretches of water-worn shells, coral fragments, rounded limestone pebbles, covered several inches deep with an almost pure culture of pteropod shells of five or six species, unusually deep for this type of ooze· This at a distance of five to thirteen miles from the outer reefs off Nonsuch. The bottom has so slight a gradient and is of so rough a nature that any gradual rolling or washing down from higher levels is unthinkable.

The discovery of a submerged sea-beach of great extent, *in situ*, at a depth of 1,500 fathoms, was quite unexpected in this part of the Atlantic

WILLIAM BEEBE

NEW YORK ZOOLOGICAL PARK

POSITION OF WOOD IN BEAVER DAMS

A TYPICAL beaver dam is a bank of earth reinforced with brush, in vertical sections approaching an equilateral triangle with a rounded apex The reinforcing branches do not show on the upstream side of the dam, the slope in that direction is covered with a thick layer of solid earth But on the downstream side the branches continue outward as a bed of brush a foot or so thick, covering the face of the dam from crest to foot, their very important function being to prevent erosion by the water flowing over the dam

Every writer known to me who goes into details of beaver dam construction, says that these branches are placed with their butts upstream Thus Morgan[1] writes in his monograph "In general the large ends of the poles and of the limbs with their branches attached were upstream, which itself would tend to strengthen their hold on the bottom"

Mills[2] says "The majority of dams are made of slender green poles With these are used occasionally small limby trees The large end of the trees is placed upstream and the bushy end downstream"

Equally definite is Dugmore[3] "As a matter of fact the building of an ordinary dam consists originally of a number of sticks and brush being laid (no stakes are driven) in the water with butts upstream"

Johnson[4] makes some qualifications "Boughs are generally found with the butt end upstream, but numerous examples occur where they lie across the current, diagonally and in every intermediate position"

And lastly Warren,[5] in the best book yet written on the beaver "Branches of willow, alder or whatever brush is most available . are cut and placed on the bottom with the butt ends upstream, and often forced into the bottom"

Now for twelve years I have been observing the work of a beaver family established on a small stream tributary to the Ottawa River near Arnprior, Ontario There is nothing out of the ordinary in the situation The stream rises in a group of springs, and with a moderate current flows a distance of two miles through a shallow thickly-wooded valley Before the beavers came it had a fairly uniform width throughout its whole length of four to six feet, and a depth varying from six inches in its upper part to three or four feet in its lower reaches The beavers occupy the last half-mile of the stream, where there is, or rather was a good supply of poplar and other favorite woods, and their dams have expanded this section of the stream into a pond four or five feet deep and about 300 feet wide

At one time and another these beavers have built nine dams, and have rebuilt or repaired five or six dams that broke In every case, both in new work and repairs, the great majority of the branches used in construction were laid with butts *downstream*, in direct opposition to the beaver practice unanimously alleged by the writers quoted As mentioned by Johnson,[4] some of the branches were placed in every possible position, but at least 90 per cent with butts downstream To venture on an *a priori* argument, it may be said that this disposition of the branches is what might be expected In general, beavers float their wood downstream naturally it is towed butt-end first to prevent twigs and branches from catching, and it is likely to be laid in position without change of direction, that is, butts downstream

Certainly such is the habitual and uniform procedure of my beavers, both in new construction and repairs There is no reason to suppose that they differ in any way from other beavers, and there does not appear to be anything in their environment that might cause a reversal of habit

I have had no opportunity of examining critically beaver dams elsewhere, but perhaps some field naturalist who is familiar with dams in different parts of the country will say if the wood in other dams really is laid with butts upstream

CHARLES MACNAMARA

ARNPRIOR, ONTARIO,
CANADA

VIRGINIA GEOLOGICAL SURVEY FIELD WORK

DURING 1931 the Virginia Geological Survey has conducted an extensive program of field work, under the supervision of the State Commission on Conservation and Development, Mr William E Carson, chairman, and Dr Arthur Bevan, state geologist The results of each of these projects will probably be published as survey bulletins.

This field work consists of the following projects:

The survey of the geology and mineral resources of the Hot Springs district in the central-western part of the state is being continued by the state geologist. He has been assisted at times by Mr C R L. Oder, of the University of Illinois, Mr. Paul Averitt, of the University of Kentucky, and Mr R. L. Laurence, of the University of Cincinnati. This area is also being topographically mapped, in cooperation with the

---

[1] Lewis H Morgan, "The American Beaver and its Works," p 103, 1868

[2] Enos A Mills, "In Beaver World," p 66, 1913

[3] A R Dugmore, "The Romance of the Beaver," p 84, n d (ca. 1914)

[4] C E Johnson, "The Beaver in the Adirondacks," *Roosevelt Wild Life Bulletin*, p. 632, July, 1927.

[5] E R. Warren, "The Beaver," p 28, 1927

U. S Geological Survey, in four 7½-minute quadrangles on a scale of 1.24,000 and a contour interval of 20 feet. The relief is about 3,000 feet The formations range from Lower Ordovician (Upper Canadian) to Upper Devonian, inclusive

Field work and a report on the Caverns of Virginia have been completed by Mr William M McGill, assistant state geologist This report is of an educational character A study of the geologic relations of the "natural wonders" in the state and a survey of the resources of certain counties are also being made by Mr McGill

Three projects are being surveyed in cooperation with the U S Geological Survey Dr Charles Butts is completing a study of the stratigraphy and structure of the Appalachian Valley in Virginia He has been assisted this season by Mr Benjamin Gildersleeve, of the University of Virginia A geologic map is being prepared for publication on a scale of 1 250,000 This will be followed by a report on the Paleozoic formations of Virginia west of the Blue Ridge

A field study of the lead and zinc district along New River in Smyth and Wythe counties has been completed by Dr Louis W Currier, assisted by Mr H E Thomas The mineralized zones occur in the Shady dolomite (Cambrian)

A study of the ground-water resources of northern Virginia has been begun by Mr R C Cady This will cover the northern tier of counties, thus including Paleozoic rocks of the northern Valley region, Cambrian and pre-Cambrian rocks of the Blue Ridge, pre-Cambrian and Triassic rocks of the Piedmont province, and Cretaceous sediments along the western edge of the Coastal Plain

A study of the Lower Cambrian red hematite beds of the Blue Ridge northeast of Roanoke is being completed by Professor Roy J Holden, of Virginia Polytechnic Institute, Blacksburg These iron deposits were extensively mined until a few years ago, and large reserves still exist

The geology and mineral resources of Brunswick County, in the southeastern part of the Piedmont province, have been mapped by Professor A A Pegau, assisted by Mr J S Johnston, both of the University of Virginia.

A study of the lower part of the Williamsburg peninsula, between James and York rivers, has been made by Professor J K Roberts, of the University of Virginia, assisted by Mr. Henry Crenshaw, of Emory and Henry College The geologic history of the Jamestown-Williamsburg-Yorktown region will be stressed in the report.

The commercial granites and allied rocks in the Piedmont and Blue Ridge provinces have been studied by Colonel Edward Steidtmann, of Virginia Military Institute, assisted by Mr. Chamberlain Ferry, of Washington and Lee University. Granite production in Virginia in 1929 had a value of more than one million dollars

A survey of the belt of kyanite deposits, in the southwestern part of the Piedmont province, has been made by Dr Anna I Jonas

The geology and mineral resources of Goochland County have been surveyed by Mr Carl B Brown, recently at the University of Cincinnati This county is in the eastern Piedmont province, including parts of the gold belt and of the Richmond Triassic coal basin

A survey of the slate resources of the Piedmont province has been made by Dr J D Burfoot, of Cornell University Commercial operations are now confined to two localities (1) In the outlying Ordovician belt of the middle Piedmont region, and (2) in Lower Cambrian (?) slates near the western margin of the Piedmont province

A study of the barite deposits is being made by Mr Raymond Edmundson, of the graduate school of Cornell University, mainly as a thesis project under the supervision of Professor H Ries The barite occurs chiefly in the south-central and southwestern parts of the state, in pre-Cambrian rocks of the Piedmont province and early Paleozoic rocks of the Valley region

The geology and mineral resources of the Warrenton quadrangle have been surveyed by Dr A S Furcron, of Western Reserve University This area includes parts of the mountainous belt of metamorphosed Cambrian rocks east of the Blue Ridge, pre-Cambrian rocks of the western Piedmont and the Triassic lowland

An areal survey of the geology and mineral resources of Giles County, which includes the well-known Narrows area along New River, is being made by Dr A L Mathews, formerly of Oberlin College The formations are Cambrian to Mississippian, inclusive Oberlin College has been giving for many years summer field courses in geology in this area under the direction of Professor G D. Hubbard

The survey of the geology and mineral resources of the Natural Bridge Special quadrangle has been partly completed by Dr H P Woodward, of Dana College, Newark, N J, assisted by Mr Robert Laurence, of the University of Cincinnati This area lies mainly in the Appalachian Valley and includes a small part of the Blue Ridge. It contains pre-Cambrian to Mississippian rocks, cut by great overthrusts.

ARTHUR BEVAN

VIRGINIA GEOLOGICAL SURVEY,
UNIVERSITY, VIRGINIA

POISONING RODENTS—AND THEN?

IN a recent Associated Press dispatch I was accredited with the unqualified statement that the grasshopper "plague" of the past summer, in parts of the Middle West, was attributable to the virtual elimination of rodents over large areas as a result of concerted poison campaigns The error which I wish to correct was the failure to quote my original statement that the occurrence of such plagues of insects is one of the results to be expected from rodent elimination Every biologist, of course, realizes that the factors determining the occurrence of grasshoppers in unwonted numbers are exceedingly complex Doubtless there are dozens of partial checks rather than a single controlling agent If there be added an item favorable to their increase, or if there be subtracted one that is unfavorable, there will be just that many more grasshoppers, but no one can predict with reason whether the increase will be one or a thousand per cent

Certainly the majority of rodents are partially insectivorous At least some, and presumably all, of the western ground squirrels are very fond indeed of catching and eating grasshoppers In the treeless parts of the West where insectivorous birds are scarce it is likely that rodents constitute the greatest active check (as contrasted with parasites, disease and adverse meteorological conditions) with which grasshoppers have to contend. But of course this has not been proven, for no extensive investigation has been made to determine what part rodents play in the destruction of harmful insects.

I venture to state that it is universally believed by biologists that as rodents are now being virtually exterminated over large areas by means of poison, their places will be taken by other, and possibly more destructive, forms of life. In a communication to Senator Walcott during 1930 I predicted that the continuance of a federal policy for the elimination of rodents over enormous areas would result in plagues of insects, such as grasshoppers, and the great increase of certain undesirable weeds In rebuttal, those desirous of arguing to the contrary will at once point out that plagues of grasshoppers have always occurred, from time to time, in many parts of the world True, of course It is merely wished to indicate that after the elimination of rodents from an area plagues of grasshoppers will undoubtedly be more frequent and more severe than formerly.

The experience of certain parts of California, poisoned several years ago with distressing thoroughness, now indicates that to the prediction of insect plagues should be added the likelihood of mouse plagues, paradoxical as this may seem. The explanation of this is probably as follows.

Under modern methods of poisoning the mortality of rodents may approach 100 per cent. and certainly reach the point at which it is impossible for local carnivores to make a living, providing of course, all these have not already been poisoned on their own account At any rate, those remaining must either starve or emigrate, practically to the last individual. On the surface, then, it seems that all rodents and all carnivores are gone, and everything should be lovely. The insidious point, however, is that within every farm house and barn are a few house mice (*Mus*), and in a number of garden patches, not poisoned out of consideration for poultry, is an occasional meadow mouse (*Microtus*) and deer mouse (*Peromyscus*) These, finding the surrounding country untenanted, radiate and, their natural enemies being absent, multiply prodigiously Unless other factors are unfavorable, in a few years there will be a mouse plague, more damaging to the farmer than if the status quo had been maintained. So, as a sequel to extensive poisoning of rodents (California alone has used over 14,000,000 pounds of poisoned grain and 6,000,000 of carbon bisulphide in the last 10 years) in its present thoroughness we may expect an increase in grasshoppers and more mouse plagues. But rodents do an enormous amount of damage and must be controlled where too destructive. The solution seems particularly clear. Rodents should be rigorously dealt with precisely where damage is being inflicted, and they, with their natural enemies, left alone as completely as practicable on waste land or where little loss is being suffered. Above all, no effort should be made entirely to exterminate rodents over wide areas, even when the process is couched in a less harsh and more soothing term than that of "extermination."

A. BRAZIER HOWELL

JOHNS HOPKINS UNIVERSITY,
SEPTEMBER 25, 1931

TREATMENT FOR POISONING BY "POISON IVY"

THE poison in *Rhus toxicodendron* and other poisonous species of *Rhus* is in the form of an oil. Dissolving the oil and throwing it away before it has time to be much absorbed into the skin is the logical treatment and is completely effective, if used promptly, and is a help even after the skin lesions are well developed. Prepare a hundred or more pinches of absorbent cotton. Use a small saucer of alcohol, 70 per cent. to 95 per cent. strength. Change the alcohol frequently. Dip a small pinch of the cotton in the alcohol and with it sop up the poisonous oil that may be upon the skin and then promptly throw it away. Do not allow any drying of the alcohol. For a small patch of the poison repeat the procedure fifty times or so. At first do not rub, but merely sop up the poison. After doing this, say, thirty times, rub well with the wet cotton before throwing away each time. Finally rub with the alcohol and cotton very vigorously to get the dissolved poison out of the "pores" of the skin. If small blisters have already formed from the poison the hard rubbing will break them and the contained poison will then be more readily removed.

Do not sop or rub more than a few moments with each bit of cotton, but throw it away almost at once. Allowing the alcohol to dry merely redeposits the poison on the skin and tends also to spread it. Do not use the same swab for repeated dipping. Throw each away at once. One hundred such pinches of cotton is enough to treat, say, two patches of poison each as big as a silver dollar. More extensive poisoning merely calls for more extensive treatment with more swabs.

This treatment is completely effective in all cases in which I have seen it tried promptly. I have not seen it tried in old cases of severe poisoning. I have never known other treatment, potassium permanganate, juice of *Impatiens fulva* or the dozens of commonly recommended "remedies," to do any recognizable good. Logically, washing the hands repeatedly in *many changes* of very strong soapsuds should remove some of the oil and throw it away, but it is seldom, if ever, carried out effectively, and at its best is far less effective than alcohol.

Maynard M. Metcalf

Johns Hopkins University,
Oct. 30, 1931

SCIENTIFIC APPARATUS AND LABORATORY METHODS

TESTING THE REACTION OF DISTILLED WATER

In talking to various scientific workers, the writer has found that a considerable number of them have the idea that pure distilled water should have a pH of 7 or near that when in contact and equilibrium with the air. Because of this erroneous conception, the writer has been prompted to write the following note of explanation.

Kendall,[1] on the basis of his own investigations and also those of others, concluded that the conductance of carefully purified water is due practically solely to carbonic acid absorbed from the atmosphere. Conductivity and pH measurements of distilled water taken directly from a still may be very misleading and largely meaningless, because under these conditions the content of carbonic acid may vary, depending upon the method of distillation, the temperature at which the water comes from the still and duration of exposure. Unless distillation takes place from an alkaline solution, or other special provisions are made, and the distillate is in all cases properly protected, there is bound to be carbonic acid present in the water. For most purposes, it is folly to go to the trouble of distilling in such a way as to remove the carbonic acid, because it will be quickly absorbed again during ordinary storage or usage of the water. Johnston[2] states that it takes only about ten minutes for unstirred water in an open beaker to come to equilibrium with the carbonic acid of the air. Since most of our experimental work involving the use of distilled water is carried on in a manner which permits contact of water with the air, it should be recognized that the water in these cases dissolves carbonic acid in accordance with the partial pressure of the carbon dioxide in the atmosphere.

On the basis of Kendall's conductivity measurements already mentioned, pure water at a temperature of 25° C in equilibrium with the atmosphere has a pH of 5.7. A test by Kendall,[3] with the indicator method of water under similar conditions, gave a pH of 5.8. Ordinary and even considerable changes in the temperature of water, causing changes in the amount of carbonic acid dissolved, influence the pH of the water but little, due to a compensation in degree of ionization of the carbonic acid which takes place. Using the indicator method, the writer has found pure water, when in equilibrium with the atmosphere, to have a pH of 5.6 to 5.8. This, as will be noted, checks remarkably well with Kendall's measurements already referred to. Laboratory air sometimes contains enough more carbonic acid to materially change the pH. The pH is, of course, also influenced by various impurities which are present in air in greatly varying amounts. The amounts of ammonia and various acids in laboratory air are often high enough to change profoundly the pH of water exposed to it. Ammonia is often present even in outdoor air in sufficient amount to affect the pH of water. During a rain or snow, this ammonia is largely washed out, and a noticeable change in the pH of water in equilibrium with the air before and after a rain or snow can often be detected with the indicator method to be described. This change is especially marked during periods of infrequent precipitation.

Neutral brom cresol purple is an excellent indicator for testing the pH of distilled water. To make the test, place about 5 cc of the water in a test tube and add 5 drops of the 0 04 per cent indicator solution Now, pour the water back and forth from one test tube to another for a minute or two, so that the water may come to complete equilibrium with the carbonic acid of the air, and then compare with proper standards If the water is of good quality and the air is of average outdoor purity, the water should assume a pH of 5 6 to 5 8 If the pH is higher than this, it is a good indication that either the water or laboratory air contains appreciable amounts of ammonia On continuing to pour back and forth for some time there may be a gradual rise in the pH, due to slow but gradual absorption of ammonia. The water comes to equilibrium with the carbonic acid of the air very much more rapidly than with the ammonia, so that, usually, the factor of ammonia in the air may be ignored It may, however, be desirable to repeat the test at an open window or door or even entirely outdoors At times even outdoor air contains sufficient ammonia to appreciably affect the test The test is so extremely sensitive that it is easily possible to detect the difference in the ammonia content of air before and after a rain or snow

---

[1] J. Kendall, *Jour. Am. Chem. Soc.*, 38: 1480–1497, 1916.

[2] J. Johnston, *Jour. Am. Chem. Soc.*, 38: 947–975, 1916.

[3] J. Kendall, *Jour. Am. Chem. Soc.*, 38: 2460–2466, 1916.

The test may also be made in the complete absence of carbonic acid and ammonia by bubbling a current of air, purified so as to be free of these gases, through the test solution The pH of good water under these conditions should approach near 7 For most purposes, however, it suffices to make the test after allowing the water to come to complete equilibrium with the air and recognizing that under these conditions pure distilled water has a pH of 5 6 to 5 8

It is important to emphasize that pure water has practically no buffer capacity and that minute amounts of impurities may be sufficient to markedly alter the pH of it In making conductivity tests of water, the same principles should be followed as in pH tests, namely, the water should either be in complete equilibrium with the air, or else carbonic acid and ammonia should be completely removed and excluded during the tests, and the results interpreted accordingly

EMIL TRUOG

DEPARTMENT OF SOILS,
UNIVERSITY OF WISCONSIN

A METHOD OF COPYING KYMOGRAPHIC RECORDS

THE physiologist or pharmacologist who during the course of a year accumulates a hundred yards or so of kymographic records must often wish, especially when he starts to write a paper, that he had in some way secured copies of those parts which are particularly convincing and illustrative, and had filed these under appropriate headings

It is not always convenient to cut up the original records, and usually it will be found best to file in one place all the tracings made during several hours of experiment on one animal Yet during that time several different phenomena may have been observed, several different experiments may have been tried, and several drugs may have been administered.

Many years ago it occurred to me that the cheapest method of obtaining a copy would be to make a print on fast bromide paper, using the smoked tracings as a negative. The method is so simple that it does not seem likely that I could have been the first to think of it, but I can not remember ever having heard of any one who used it If the kymograph paper is well and evenly smoked and not handled overly much by greasy fingers the copy may be more clearcut and better suited for publication than is the original

WALTER C ALVAREZ

DIVISION OF MEDICINE,
THE MAYO CLINIC,
ROCHESTER, MINNESOTA

APPARATUS FOR OBSERVATION OF A SMALL OBJECT WHILE FLOODED WITH VARIOUS SOLUTIONS

IN attempts to study the effects of various solutions upon individual nematode ova and coccidia, need has been felt for an apparatus which would allow continuous observation of an individual object before, during and after it was subjected to the action of chemical solutions. Following is a description of such an observation cell which has proved to be very satisfactory for this purpose

Two small trough-like depressions, (A, A′), about 0 4 mm deep are ground into the surface of an ordinary microscope slide This is quickly done by holding the surface of the slide against the edge of a small carborundum wheel Next, a glass tube of approximately 5 mm in diameter is heated and a portion drawn to a diameter of about 0.5 mm, while at the same time the portion of the tube at the constriction is bent to form a right angle The smaller portion of the tube (B) serves as the inlet to the observation

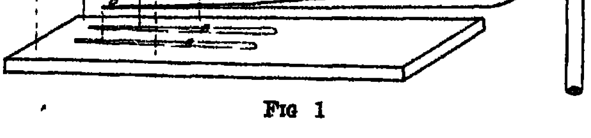


FIG 1

cell, while the larger portion of the tube (C) becomes the reservoir for the fluid to be introduced into the cell. The smaller portion of the tube is placed in the trough in the slide with the reservoir in a vertical position, and sealed in place by means of De Khotinsky cement or sealing wax For an outlet to the observation cell, a small glass tube (D) is drawn to approximately 0 5 mm and the opposite end bent to form an inverted U This tube is placed in the other trough and similarly fastened in place, while the inverted U at the end prevents the liquid from running back along the tube A cover glass (E, E′) is sealed over the ends of the troughs in such a way as to enclose the ends of both tubes The side of the cover glass (E′) over the inlet and outlet tubes will be held a small distance above the surface, which will result in a small slant in the cover glass, giving a varying depth to the observation cell

The material to be studied is introduced into the reservoir, where it drains into the observation cell With the outlet closed by the finger, air pressure is exerted against the contents of the reservoir (C) with the result that the cover glass is slightly sprung, and the solid objects are forced between the cover glass and the slide where they become trapped with the release of the pressure and the return of the cover glass Because of the varying depth of the cell it is now possible to select an individual object so located as to be firmly held by the cover glass, but not crushed or distorted By adding any liquid to the reservoir, a constant bath of the desired liquid can be maintained around the object, while the object remains in focus in a photomicrographic camera or under a microscope No difficulty has been encountered in maintaining coccidia in focus under either a No 6 Leitz dry or a 1-7 oil immersion objective.

ERNEST C MCCULLOCH
DEPARTMENT OF VETERINARY SCIENCE,
COLLEGE OF AGRICULTURE,
UNIVERSITY OF WISCONSIN

A SIMPLE DEVICE FOR HOLDING ULTRAFILTRATION MEMBRANES

THE use of filtration through collodion membranes as a means of purifying biological products and determining the size of colloidal particles is becoming more wide-spread. Many apparatuses have been described to hold the membranes but their construction requires special glass blowing or machine work. The device described here can be prepared in any laboratory

The filter membrane is held between two glass funnels and is protected from their ground edges by a rubber washer above, and a rubber band stretched over a metal washer below the membrane (Figure 1)

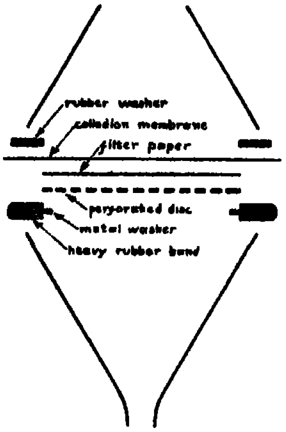


FIG 1

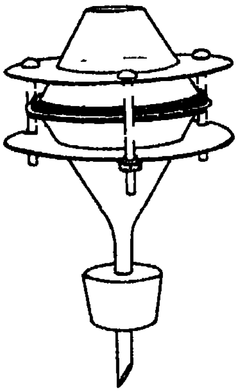


FIG 2

The metal washer supports a perforated disc upon which is placed ordinary filter paper of the same diameter When assembled, the top of the rubber band and of the filter paper are in the same plane, to prevent distortion of the membrane under pressure The filter paper between the collodion membrane and perforated disc serves to increase the effective filtration area

The funnels are clamped together by two rings of metal or Bakelite as shown in Figure 2 If the filter is to be autoclaved metal rings are advisable In using metal rings, holes are drilled around their inner edges and a narrow strip of rubber woven through the holes and around the inner edge of the ring, forming a cushion between the funnels and rings

When autoclaving, the membrane is replaced by filter paper and the apparatus is clamped loosely After sterilization, the filter paper is replaced by the collodion membrane

CHARLES BREEDIS
THE HENRY PHIPPS INSTITUTE,
UNIVERSITY OF PENNSYLVANIA

THE NATIONAL ACADEMY OF SCIENCES. III

The oxygen carriers of the blood in their relation to sex and season. OSCAR RIDDLE For only two or three species of animals has it been definitely known that hemoglobin and red cells exist in different quantity in the blood of the two sexes, and seasonal changes in these values are very little known. Data of Riddle and Braucher make it clear that in two additional species—ring dove and pigeon—this sex difference is present, that here also these oxygen carriers exist in larger amount in male blood, and that hemoglobin and red-cell values markedly change with season. Riddle, Christman and Benedict have measured the basal metabolism of these same animals and find that the metabolism also undergoes marked seasonal change. In two species it is thus found that the metabolism, the hemoglobin and the red cells are all decreased to their lowest point in summer and all attain their highest values in the autumn—the season at which these animals were subjected to air of greatest cooling power All these changes occur in individuals of both sexes The implantation of male germ glands (testes) into castrated female birds and mammals is known to produce an increase in the hemoglobin or the cell count, or both, in the blood of the castrate, and it has been claimed that this demonstrates that hemoglobin and erythrocytes are secondary sex characters The new data prove that this conclusion is unsound The secondary sex characters of birds and mammals represent specific responses of developing parts, areas or tissues to a specific sex hormone, they do not respond to changes in basal heat production as such Hemoglobin and erythrocytes, however, do undergo their major fluctuations—both increase and reduction—in close correspondence with the seasonal changes in metabolism. The oxygen carriers of the blood fluctuate with the oxygen demands of the tissues, and their sex difference reflects unequal oxygen demands of male and female tissues These oxygen carriers therefore appear to reflect primary sex difference and to contribute further evidence for the metabolic theory of sex

The present status of wire-wireless broadcasting on power lines GEORGE O SQUIER. As a research student in physics and electrical engineering under Rowland and Duncan in "the golden age" of the Johns Hopkins University over forty years ago, I well remember the discussions which then took place as to the relative merits of direct and alternating current for power transmission. When the alternating current system began to appear the major decision to be made was to select the frequency. Little did the small group which formed a part of the "Big Eight" realize that when the number 60 cycles per second was selected after wide discussion throughout the small engineering profession in the United States at that time, at a single stroke a step was taken which has determined the design of the whole vast power-wire pattern which to-day links this country from ocean to ocean, and from the Great Lakes to the Gulf of Mexico To-day this aristocratic number 60 throbs incessantly throughout a vast territory extending from the remote farmer's cottage to the heights of the Empire State Building in New York City. This national pendulum ticks with a regularity and accuracy which permit us to live in a split-second world which it has created There was another key decision made at that time whose history is not so easy to determine. Some unknown mechanic or electrician casually decided to construct the standard lamp socket of the diameter of one inch, and to employ the basic principle of the screw for reliable electrical contact To-day the number of these standard sockets in use in the United States is roughly estimated as $50 \cdot 10^7$. On September 18, 1910, for the first time, two separate telephone conversations were carried on over a single "twisted pair" wire telephone circuit between the Signal Corps Laboratory at the National Bureau of Standards in Washington, D. C., and the small laboratory at 1710 Pennsylvania Avenue. Then was born the new art of wire-wireless communication engineering. At the annual meeting of this academy in April of the present year, I brought to the attention of the academy a new development of wire-wireless called the monophone, or one-way telephone, for broadcasting and pointed out at that meeting the astonishing fact that our telephone plant, which has now reached 80 million miles of wire, was operating only about 18 minutes a day or at an "overall inefficiency" of some 98 per cent. The magazines recently announced that these idle wire facilities are being reserved for a two-way long distance television service as supplementary to the point to-point service on the regular telephone plant. At 4 p m on March 24, 1922, in the presence of the Associated Press and a group of radio engineers, occurred the first demonstration of wire-wireless broadcasting of programs on the regular standard electric light circuit in the office of the chief signal officer of the army, in the Munitions Building, across the street from the National Academy of Sciences Building in Washington. To-day after nine years I have to report a practical development extending continuously throughout this period at a cost of some three millions of dollars where at present a staff of 75 men are employed in the laboratory at Ampere, New Jersey. Superimposed upon the 60 cycle power transmission plant without interference, is a 13 kilocycle carrier current which is stepped up in multiples of the lucky number 13 to deliver three separate programs simultaneously into the homes of subscribers from the standard light socket on frequencies of 26, 39 and 52 kilocycles per second. The complete equipment designed, manufactured and tested for 270,000 homes is now ready for shipment to Cleveland, Ohio.

A critical study of the magneto-optic method of analysis· JACOB PAPISH and A. C. SHUMAN (introduced by W. D Bancroft). The magneto-optic method of analysis was applied to the identification of a number of chemical elements. The method was found inadequate in the case of mixtures, and the authors call attention to the fact that further study may throw light on the cause of "minima" observed when solutions are examined by this method.

The Zeeman effect in the $^2\Sigma$, $^2\Sigma$ band spectrum of calcium hydride. WILLIAM W WATSON (introduced by F. Schlesinger). This paper deals with the effect of a magnetic field on the energy levels of the type known as $^2\Sigma$ for diatomic molecules, with the object of learning more about the dynamics of such molecular states. The $^2\Sigma$, $^2\Sigma$ band spectrum of calcium hydride in the region of 6350A serves the best for this investigation because of the record size of the doubling of the energy levels involved, the wide spacing of its lines and its position in the spectrum. The spectrum has been photographed at various strengths of the magnetic field up to 80,000 gauss, and the resulting measurements compared with the patterns of the spectral lines as predicted by existing ideas of the dynamical behavior of molecules in $^2\Sigma$ states. The results show that the magnetic interaction is largely that of an electron spin of ½ a Bohr unit and the external field, superposed on the internal coupling of electron spin to the rotational axis of the molecule Marked asymmetries in the patterns appear for lines arising from the higher rotational levels of the molecule, however, which can be attributed to the presence of a sizable component of electronic orbital angular momentum along the axis of rotation Data on the relative intensities of the different kinds of energy transitions in the presence of the magnetic field are also presented.

Imaginary geometry and relativity: EDWARD KASNER

Applications of relativistic thermodynamics to cosmological problems RICHARD C TOLMAN For several years the author has been endeavoring to develop the principles for an extension of thermodynamics to general relativity, which would make it possible to treat the thermodynamic behavior of systems under circumstances where the gravitational field can not be neglected. The purpose of the present paper is to give a brief summary of the results that have been obtained by applying the new principles to several problems which might be of interest for cosmology Some of these results have previously been published The principles were first applied to systems in static thermodynamic equilibrium. In the case of a non-uniform static gravitational field, it was shown that the conditions for thermal equilibrium would necessitate a definite temperature gradient in order to prevent the flow of heat from regions of higher to those of lower gravitational potential And, both in the gravitational field of a spherical distribution of fluid and in that of a static Einstein universe, it was shown that the concentration of matter in equilibrium with radiation, assuming their interconvertibility, would be the same as in flat space-time. The principles were then applied to non-static systems in which reversible processes take place. Possibilities were found which do not exist in the classical thermodynamics for processes to take place at a finite rate and nevertheless reversibly without increase in entropy. It was shown that several different models of the universe could expand or contract at a finite rate and yet reversibly without increase in entropy; and a number of phenomena were found in the case of reversibly expanding universes, such as the outward flow of radiation, which have ordinarily been interpreted as irreversible. The possibilities for periodic expansion and contraction of the models was also studied, and it was shown that although no strictly periodic solutions of the equations of motion are possible, nevertheless, quasi-periodic motions are allowable which would in effect give a series of identical expansions and contractions without increase in entropy Finally, the new principles have been applied to non-static systems in which irreversible processes take place. Owing to the well-known fact that the principle of the conservation of energy does not hold in relativistic mechanics in the same simple form as in classical mechanics, it is found that the possible increases in entropy which accompany the occurrence of irreversible processes in an isolated system are not subject to a limitation such as imposed in the classical thermodynamics by a fixed constant value for the energy of the system. Indeed, models of the universe can be conceived which would undergo a succession of irreversible expansions and contractions without the entropy reaching an unsurpassable maximum where further change would be impossible

The equation of state of real gases and its quantum dynamical correction HENRY MARGENAU (introduced by F Schlesinger) The equation of state of a gas is a mathematical expression of the manner in which the pressure changes when temperature and volume are varied Its usual derivation is based upon the picture according to which each molecule may move freely in space and attracts every other molecule with a force depending on the distance of separation. There is no restriction upon the velocity which any given molecule may possess By quantum dynamics it can be shown that, under the action of attractive forces of the actually existing type, pairs of molecules may, under certain conditions, form a loose combination, different from a chemical bond When two structures are bound together in this way they vibrate in a definite manner with roughly calculable frequencies, which make it impossible for the individuals to have any velocity whatever. Hence, in the calculation of the equation of state, these impossible velocities must be excluded In the present paper this calculation is carried through The result does not differ appreciably from the usual one if the gas is considered at high temperatures, but at low temperatures a considerable difference arises. While it is difficult at present to make accurate numerical comparisons between the theoretical formula and empirical observations, the corrections which this theory imposes are qualitatively in line with the available experimental evidence.

A new photographic map of the Moon: F. E WRIGHT and F G. PEASE. In selenographic literature the question of possible changes in the surface features of the Moon is under constant discussion and the answer is sought in a comparison of early, with more recent, maps and descriptions. No satisfactory decision has been reached because all maps heretofore produced have been drawn by hand and these are subject to personal factors difficult to evaluate The present series of maps seeks to eliminate the personal factor and to produce, with the best means at present available, a series of photographic maps in which the photographs taken with the 100 inch Hooker telescope at Mt. Wilson Observatory are transformed by a special method of projection, so that in each photograph the Moon is viewed along the standard line of sight normal to the plane of mean libration. The principle of transformation is similar to that used in airplane mapping; but the method adopted is quite different because the whole lunar hemisphere is involved and not simply the transformation from one plane surface to another.

Metabolic activity of the bacterial cell C.-E. A. WINSLOW and HAROLD H. WALKER (introduced by G. P. Clinton). Bacteria of the colon group have been cultivated in vessels continuously aerated during the course of the experiment with air which had been freed from carbon dioxide and ammonia. The effect of the aeration procedure on growth was determined and average curves plotted for the population cycle. Specific growth phases of short duration were selected at various points on the population cycle and simultaneous determinations made, at the beginning and end of each phase, of bacterial increase, reaction change in the medium, sugar consumption, change in CO_2 and NH_3 content of the medium and aeratable CO_2 and NH_3 collected by the air train during such period. This method of cultivating bacteria in a continuously aerated medium gives a more normal picture of the life cycle of a bacterial population than that obtained in ordinary techniques which involve the rapid inhibition of the organisms by their own waste products. Three basic media were used, 1 per cent. peptone solution, a solution containing ½ per cent peptone and ½ per cent lactose and a simple synthetic medium (the Dolloff medium) containing ammonium tartrate as a source of nitrogen and lactose as a source of energy. There is a definite life cycle for each medium, involving (a) a preliminary lag with little change in population, (b) a logarithmic increase in numbers and (c) a period of relative stability. The process of aeration, it is interesting to note, is highly favorable to development in the lactose and peptone media through the removal of toxic waste products, but is distinctly inhibitory in the simple synthetic medium, presumably through the removal of growth stimulating substances. The principal results to date appear to be the demonstration that the production of both carbon dioxide and ammonia nitrogen per cell increases enormously during the period of active multiplication or logarithmic increase. Late in the preliminary lag period and in the phase of logarithmic increase the culture produced $40–100 \times 10^{-11}$ milligrams of CO_2 per cell per hour, while in the later period of stability the figure fell to $1–2 \times 10^{-11}$. For ammonia-nitrogen, the rate of production during the late lag phase was about 15×10^{-11} mgm per cell per hour and for the phase of logarithmic increase, 4×10^{-11} while for the phase of ultimate stability ammonia production fell to 0.2×10^{-11}. During the lag phase the ratio of carbon dioxide to ammonia nitrogen is about 4, during the logarithmic phase over 10 and during the period of stability when growth balances death about 6, expressed in relative weights of the gases yielded. If we compare the metabolism of the cells during the period of lag and of logarithmic increase with their metabolism during stability of population we find that CO_2 production is increased thirty-fold and NH_3-N production 20–70 fold. The ammonia formed may of course be largely derived from extracellular decomposition of pepton. The increase of CO_2 production, however, would seem to be a measure of increased metabolism due to the physiological condition of the actively multiplying cells.

The physical and behavioral development of a female chimpanzee during the first year of life C. F. JACOBSEN (introduced by R. M. Yerkes).

Some observations of the behavior of chimpanzees in a native habitat H. W. NISSEN (introduced by R. M. Yerkes).

Reinforcement and inhibition of eyelid reflexes to light and sound ERNEST R. HILGARD (introduced by R. Dodge). A faint stimulus, itself eliciting only minimal reflex responses, may greatly exaggerate or depress the responses to a more adequate stimulus which follows it. This is demonstrated in certain experiments on the human eyelid reflex, in which a faint light preceded a loud sound. The light alone evoked winking responses averaging 4 mm in extent, while the sound evoked winking responses averaging 20 mm. When the light preceded the sound by appropriate intervals (of from 0 to 050 sec.) the response to the sound was increased to a maximum average extent of 31 mm, an increase of 11 mm above the normal. This increase of 11 mm is due to the prior occurrence of a light which alone evoked a response of but 4 mm. On the other hand, the response to sound may be greatly decreased in extent if the light precedes the sound by a slightly lengthened time interval (interval of 075 sec. or greater). This inhibitory effect is even more pronounced than the reinforcement just described. The reaction to sound may fall as low as 1 mm in extent from the normal of 20 mm, a drop of 19 mm. All the eyelid responses were recorded by the photographic method of Dodge, using his pendulum photochronograph. The experiments point to the importance of the faint stimuli playing upon the organism and creating the dynamic background into which a new stimulus is received. The responses to the new stimulus will be greatly modified by immediately preceding events. The reversal of effect from reinforcement to inhibition with fine changes in time relations bears importantly on the theory of conditioned reflexes widely used by psychologists in explanation of habit formation.

Some psychopathological aspects of the personality of the scientist: DR. EUGEN KAHN (introduced by Dr. Raymond Dodge). Every personality is a complex combination of physical, impulse, temperament, instinct, intelligence and character factors. The individual combination of these factors is decisive for the personalities' attitudes. Evidently all these factors must be present, to some degree, in the scientific personality. It may be desirable to consider three special attitudes which seem to be outstanding in the personality of the scientist: Ambitendence, anancasm and paranoia.

SCIENCE

Vol 74 Friday, December 25, 1931 No. 1930

The Rise of Man Professor James H Breasted 639
The National Academy of Sciences·
  Award of Gold Medals to Dr Annie J. Cannon and Professor Henry B Bigelow, Centenary of the Birth of Othniel Charles Marsh 644
Scientific Events
  Ecological Nomenclature, Exhibit of Specimens of Himalayan Flora at the Roerich Museum, The International Meteorological Organization, The Fourteenth International Congress of Physiology, Presentation of a Portrait of Professor Charles E Munroe to the Cosmos Club 648
Scientific Notes and News 651
Discussion
  Gambusia in Foreign Lands Dr. Samuel F Hildebrand *The Common Earthworm as a Serious Economic Problem* Dr. C T Hurst *Conical Hailstones*. Professor A T Jones *The School Days of Lorentz* Professor Arnold Dresden *The Work of Dr Baskerville* Nathan Van Patten *The Term Protein* Dr. P A Levene 655
Special Correspondence
  Twenty seventh Annual New England Intercollegiate Geological Excursion Professor Marland Billings 658
Reports,
  Doctorates Conferred in the Sciences by American Universities 1930–31. Dr. Clarence J West and Callie Hull 659
Scientific Apparatus and Laboratory Methods
  The Use of Micro manipulators Professor J F McClendon *Rapidly Ripened Haematoxylin and Its Uses* W H Camp *Heavy Glassware in the Laboratory* Professor E G Hastings and I L Baldwin 661
Special Articles
  Phosphorus Intake in the Diet and Blood Phosphorus Concentration, in the Experimental Production of Caries Immunity and Caries Susceptibility in the Rat Dr Henry Klein and Professor E V McCollum *On the Ultra-violet Photomicrography of Living Cells* Dr Ralph W. G Wyckoff and Adrian L Ter Louw *Element 87* Dr C F Graham 662
Science News 10

SCIENCE· A Weekly Journal devoted to the Advancement of Science, edited by J McKeen Cattell and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C

THE RISE OF MAN[1]

By Professor JAMES H BREASTED

ORIENTAL INSTITUTE, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

We are gathered here this morning to give some thought to the purpose and meaning of a new building associated with a great university If this were a new building intended for the study and teaching of some branch of natural science, such as geology or chemistry or physics, we would seem to be engaged in a routine familiar to us all, for such laboratories have long been known to us at other large universities. It is an interesting fact, however, that we would find no parallel to this building in any other university, either in America or abroad. Far from mentioning this fact by way of gratifying our own vanity, I call your attention to it because it is a fact of which I am constantly conscious as laying upon us a great and unique responsibility. It is a fact which obviously raises the question "Why." When other universities have not recognized such a need, why this new building here and why the researches to be housed in it?

I have lived for more than forty years in daily realization of the need of such a building, and to me the natural question seems rather to be. "Why should science, which builds its laboratories to investigate the history of every other creature from the frog to the horse, never have created a laboratory for the investigation of early man, the most important of all creatures?" The investigations centering in this building make it a laboratory devoted to man, to his origins and the evolution of the civilization which we have inherited. The life going on in this building invites you to a new vision of the place of man in a universe out of which he has issued with new and sovereign powers to understand something of that universe and his own place in it.

Man's Place in Nature

For ages man has seen himself against a background of nature Gradually his own achievements have profoundly modified his ideas of his own position in the visible world about him. When Stone Age man shifted from hunting to agriculture and for the first time felt his dependence on the fruitfulness of the earth, it led him to deify the fertility of the green fields and to take his place as a child of the god of fertility It gave him a very simple idea of his place in the natural order Since those primitive days the profoundest minds have struggled with the problem of man's place in nature The self-development which was such a profound influence in the growth of Goethe's mind was conditioned by the expanding consciousness of his own kinship with nature and the belief that somehow man had come out of nature These thoughts eventually issued in Goethe's profound conviction of his spiritual oneness with nature A quarter of a century after Goethe died, Darwin published his "Origin of Species," and thereupon the conception of man's place in nature hardened into mechanical and largely biological aspects of the emergence of man It was especially in the writings of such men as the Frenchman Taine that these mechanistic and biological conceptions revealed their devastating effect upon a trained mind, even though enriched by literary culture Under the light of modern science and its terrifying revelations, man has begun to fear the tremendous idea that he is an outgrowth of the universe that holds him in its immutable grasp To be sure, some minds like that of Tennyson have kept alive the spiritual attitude so strongly held by Goethe We really hear an echo of Goethe as we contemplate the figure of Tennyson standing by the cradle and for the first time looking into the face of his first-born son, with the words, "Out of the deeps, my child, out of the deeps"

---

[1] Address given on the occasion of the dedication of the Oriental Institute of the University of Chicago.

In an evolutionary age, however, there was little upon which this mystically spiritual attitude of Tennyson could be based

The Gap in our Knowledge of the Human Career

Since then the natural scientists have labored on and the physical origins of man from the lower animals have become far clearer But between the historians and the natural scientists there has been a "great gulf set," with the result that we now have on the one hand the paleontologist with his picture of the dawn-man enveloped in clouds of archaic savagery, and on the other hand the historian with his reconstruction of the career of civilized man in Europe Between these two the paleontologist with his archaic savage on the one hand, and on the other the historian with his account of civilized Europe, stand we Orientalists endeavoring to bridge the gap. It is in that gap that man's primitive advance passed from merely physical evolution to an evolution of his soul, a social and spiritual development which divests evolution of its terrors It is the recovery of these lost stages, the bridging of this chasm between the merely physical man and the ethical, intellectual man which is a fundamental need as man faces nature to-day We can build this bridge only as we study the emergence and early history of the first great civilized societies in the Ancient Near East, for *there* still lies the evidence out of which we may recover the story of the origins and early advance of civilization, out of which European civilization and eventually our own came forth

The Organization Needed for Bridging the Gap

That is the greatest task of the humanist to-day, but no group of Orientalists, however gifted or able, if organized solely as a university department, as teachers of the history and the languages of the Orient, can undertake to recover the evidence still lying scattered far across the hills and valleys of the Ancient Near East What is required in the first place is such an organization as will permit the employment of a large group of efficient field men with practical archeological training, who can be associated with the philologists and historians of a university department of oriental languages If sufficient funds are available the field staffs and the home department can cooperate in a far-reaching, two-fold process, first, of salvaging the vast body of evidence still surviving in the field, and second, of studying and interpreting the evidence as it is received from the field by the scientific staff at home Thus the formerly more or less helpless university department of oriental languages becomes part of an effective organization, in which it serves as the interpretative organ We thus link together the far-flung salvaging operations in the field and the interpretative group at home in one great cooperative organization

The Oriental Institute

This organization of home and field staffs, which we have called the Oriental Institute, began its work in the autumn of 1919, and is therefore twelve years old Its resources were at first very modest, consisting of a subscription of $10,000 a year for five years, contributed by Mr John D Rockefeller, Jr, in the spring of 1919 This personal subscription by Mr Rockefeller, Jr, steadily increased, and at the same time the General Education Board and the International Education Board made large appropriations for the expansion of the new institute. It was, however, not until five years ago that the Oriental Institute was able to launch a comprehensive program of research, providing for a field expedition in each of the great ancient oriental civilizations of the Near East: These are now at work in Anatolia (Hittite civilization), Syria, Palestine, Assyria, Babylonia, Persia, Egypt and Northeast Africa, making a total of twelve expeditions. They form the most far-reaching archeological organization ever projected.[2]

---

[2] At this point congratulatory cablegrams received by the Institute from these expeditions were read by the

Thus for the first time a single organization is now able to control and to correlate the results of research and excavation throughout the leading early civilizations in a single composite reconstruction of the course of ancient human life before the rise of Europe. A small fraction of the evidence thus far recovered is installed in the museum halls which we are about to visit.

We shall pass through these halls, five in number, in the following order: Egypt, Assyria, Babylonia, Persia and Islam, Palestine and the Hittites.

WESTERN ASIA AND THE RISE OF BUSINESS AND LAW

These names at once suggest the diversity of peoples which produced the composite civilization of Western Asia. Indeed, the history of Western Asia is made up of one brilliant eruption after another, arising from the intermingling of invaders and invaded. There is no unbroken evolution of a single society stimulated by the ferment and friction of its own internal forces. The foreign invader periodically diverts the development into new channels, and produces sudden dislocations in the evolutionary process, like the fall of Nineveh before a combination of foreign foes, or the capture of Babylon by Cyrus and the Persians. It is a vast and intricately complicated mosaic which we are endeavoring to piece together in Western Asia.

It was a still greater complex of civilization resulting from the commingling of the life of Egypt and Western Asia which eventually reached Europe and furnished the cultural basis on which European civilization arose. It was in the Near East that man developed the whole material basis of life, as grain and cattle, wool and manufactured merchandise gradually built up the earliest commercial world in the Near East at a time when Europe was still primeval forest. In the thousand years between 3000 and 2000 B. C., the merchants of Babylonia created the idea of credit which still binds together the great people of the world or leaves them helpless and disorganized when its cementing power breaks down, as it now seems to have done. You can enter our Babylonian halls and see there masses of business documents some of them reaching back to nearly 3000 B. C. The commercial and social relations which produced them built up a body of business customs which became inviolable and gradually took shape in laws, which long before 2000 B. C. were put together in a highly developed form by the great Hammurabi, whose remarkable code you may see in replica in the Babylonian Hall. Thus the work of man's hands in agriculture, cattle-breeding, manufactures and building merged into more highly developed forms of human organization. Society gained classes and men of gifts gained leisure.

THE RISE OF ART, LITERATURE AND SCIENCE

This situation made possible the earliest flowering of art and literature as the human mind discerned entirely new and undiscovered ranges where it might wander. In an address so brief, I can not even suggest the character and achievements of the earliest national art in Egypt and Western Asia. That until recently little was known of it, even in this university, may be observed from the fact that in his opening lecture, inaugurating the Renaissance Society, one of our own colleagues summarized the art of the Orient as "the winged bulls of Assyria and the jackal-headed Anubises of Egypt." In spite of this terrifying epigram we have since annexed one of the said winged bulls, and you can this morning decide for yourselves whether you regard it as successful art.

In literature I can make only one reference. I could show you a papyrus containing a government report embedded in which is a single statement disclosing admiration of a beautiful scene along the Syrian Coast. It was written in the twelfth century B. C., and it is the earliest surviving expression in human speech of man's love of beauty in nature—the beginning of a long development which has culminated in the poetry of Shelley and Wordsworth.

Through the obscuring veil of superstition men looked out upon a mysterious world, which they longed to understand, as we do to-day. The demand to do so was at first a social summons, the need of human suffering, which called forth efforts at alleviation. The oldest known treatise on surgery, which was written in Egypt nearly 5,000 years ago, discloses to us the thoughts of the earliest man who reveals a scientific attitude of mind. This treatise is therefore the earliest document in the history of science.

Less than a thousand years later the Egyptians were already writing mathematical treatises of astonishing penetration. The area of the circle was computed by taking eight ninths of the diameter and squaring it. The value of π thus gained was 3.1605, which differs less than two one hundredths from the value of π current at the present day. This led to a formula for computing the area of the surface of a hemisphere, a method rediscovered by the Greeks 1,300 years later. A recently deciphered papyrus at Moscow has disclosed a surprising ancient Egyptian formula for the computation of the cubical contents of a truncated pyramid, that is a pyramid cut off part way up in a plane parallel with the base. This formula, which was unknown to the Greeks, was first stated in Europe by Leonardo of Pisa in A. D. 1220,

---

speaker, including a remarkable forty-eight line inscription of Xerxes, just discovered at Persepolis.

three thousand years after it had been discovered by the Egyptians.

The supreme achievement of science in the Orient was Babylonian astronomy. As far back as the twenty-third century B. C. the Babylonian astrologers observed an eclipse of the moon which has been calculated to have occurred in 2283 B. C. But at that remote date such observations were only occasional, and they were likewise very inaccurate and unsystematic. Gradually it became customary to make more frequent observations, until 747 B. C., in the reign of the Babylonian king Nabonassar, the series of observations became continuous and a record of them was carefully kept on file. This file furnished the first long series of astronomical observations ever made by man, and therefore the first great body of astronomical knowledge. It is an extraordinary fact that modern astronomers have not yet been able to accumulate a series of observations equally long. The Babylonian series continued for over 360 years, while the longest known series of modern observations, that at Greenwich, which began in 1750, has now been going on about 181 years, or about half the length of the Babylonian series.

The use to which the Babylonian astronomers put these scientific archives is an astonishing demonstration of the scientific attitude of mind. About 500 B. C. the Chaldean astronomer Naburimannu was able to calculate the annual movements of the sun and moon with an error of less than ten seconds for the entire year. A little over a century later the Chaldean astronomer Kidinnu, whom the Greeks called Kidenas, greatly surpassed this accuracy, reducing the error in a year's revolution to one second. Indeed, one of his measures of celestial motions even exceeds in accuracy the figures that have long been in practical use by modern astronomers. This was because he had before him 360 years of lunar observations, and no modern astronomer has any such body of records at his disposal. Eventually Kidinnu discovered the slow change in the obliquity of the earth's axis which we call the precession of the equinoxes, an achievement hitherto attributed to the Greeks.

THE GREEKS INHERIT BABYLONIAN ASTRONOMY

It is now obvious that Thales made his famous prediction of a solar eclipse on the basis of Babylonian observations, and we now know also that when the Greek engineer Meton was trying to introduce a scientific calendar at Athens, he took the length of his year from the Babylonian Naburimannu. These two remarkable Babylonians, Naburimannu and Kidinnu, who first revealed to men a majestic system of the celestial world and thus became the founders of astronomical science, were an imperishable scientific and intellectual bond between the early East and civilized Europe.

UNDISTURBED EVOLUTION OF CIVILIZATION IN THE NILE VALLEY

Such glimpses of early man's intellectual conquests, as revealed in surgery, mathematics and astronomy, disclose to us the fact that man was advancing for thousands of years at many points along a wide and imposing front. In Western Asia, as we have seen, that front was broken up by invasions and shifting movements of early populations which produced constant complications and make it increasingly difficult to follow the human advance. In the Nile valley, however, safe frontiers, while by no means impenetrable, made ancient Egypt a kind of social laboratory where we may watch almost uninterruptedly the successive stages of human evolution.

As you enter the Egyptian Hall in this building, you will find at the right a group of stone implements, all of which were found embedded in geological formations in the Nile valley. They therefore belong to known geological periods. They stretch from the earliest known stone artifacts almost down to the Late Stone Age or the Neolithic, and they form the first such geologically dated series of stone tools, covering a period of many thousands of years, ever discovered. During the period which produced them the Nile cut down its channel through a hundred vertical feet of solid rock. It was not until long after this period of probably several hundred thousand years, which we can follow only in gradually improving stone tools, that man gained cattle-breeding and agriculture. Thereupon with the development of a settled manner of life, the evolution gradually became a social process.

MAN'S EARLIEST TRIUMPH OVER MATERIAL FORCES

From that time to this, man's life has been periodically involved in a struggle between the tremendous impression received from the natural world and the humaner impulses that are engendered by social experience and social struggle. In the Nile valley we can watch the first of these periodic struggles, and with sympathetic understanding we can follow the first great age of spiritual disillusionment. We watch the triumphant conquest of material forces, at first slow and then moving with astounding rapidity as these ancient Nile dwellers came completely under the spell of their material triumphs.

In the Cairo Museum you may stand in the presence of the massive granite sarcophagus which once contained the body of Khufu-onekh, the architect who built the Great Pyramid of Gizeh. His name means "Khufu lives," or in its Greek form "Cheops lives"—certainly a significant name for the builder of a pyramid which is still the greatest of all masonry buildings. Who does not know the "Pyramid of Cheops"? Let us in imagination follow this early architect to the desert plateau behind the village of

Gizeh. It was then bare desert surface, dotted only with the ruins of a few small tombs of remote ancestors. The oldest stone masonry construction at that time had been erected by Khufu-onekh's great grandfather. Only three generations of architects in stone had preceded him. We can easily imagine Khufu-onekh's grandfather saying to him, "My father put up the first stone building ever erected in Egypt." There probably were not many stone masons, nor many men who understood the technique of building in stone as Khufu-onekh took his first walk on the bare Gizeh plateau, and staked out the ground plan of the Great Pyramid. Conceive, then, the dauntless courage of the man who told his surveyors to lay out the square base 755 feet on each side! When that was done Khufu-onekh was looking out over a square of naked desert containing thirteen acres. He must have looked across the Nile at the quarries some thirty miles distant, and perhaps he made a quick calculation. "It will take nearly two and a half million blocks each weighing 2½ tons to cover this square of thirteen acres with a mountain of masonry 481 feet high, but I will do it!" This is the first time in the history of man that we are thus able to put our yardstick athwart a human mind and take the measure of its courage in terms of cubic feet of masonry and colossal achievement in engineering never again to be equalled. The Great Pyramid of Gizeh is thus a document in the history of the human mind. It clearly discloses man's sense of sovereign power in his triumph over material forces. For himself and for his sovereign the Pharaoh's engineer was achieving the conquest of immortality by sheer command of material forces—an immortality that consisted in survival of the king's body sheathed in an imperishable husk of masonry.

THE EGYPTIANS, THE DISCOVERERS OF CHARACTER, MAN DISCOVERS THE INNER VALUES, THE DAWN OF CONSCIENCE

Here then was a man still under the tremendous impression of the physical world, the world about him, but not yet aware of the world within him. When five or six hundred years of desert storms had buffeted the Great Pyramid of Gizeh and its companions on the Sahara plateau, a thoughtful Egyptian looked up at the pyramids and sang of the colossal futility of merely physical survival of the body. The human soul had entered the first great age of disillusionment. We begin to hear remote voices that proclaim the utter futility of material conquest. As if, through the dust and tumult of an engrossing conflict, man for the first time caught something of the veiled splendor of the moral vision. He began to hear the voices within himself and out of the conflict of social forces, he gradually became conscious of the inner values. Thus the Egyptians were the discoverers of character. Not projected from the outside into a world of unworthy men by some mystic process which our old school theologians called inspiration or revelation, but springing out of man's own life, illumining the darkness of social disillusionment and inner conflict, a glorious vindication of the worth of man, the dawn of the age of conscience and character broke upon the world, a historically datable event, about 2000 B. C. It was the outgrowth of man's own social experience. It sprang out of his own soul, and no outworn theological doctrine of inspiration, no conception of a spotlight of Divine Providence shining exclusively on Palestine, shall despoil man of this crowning glory of his life on earth, the discovery of character.

EARLIEST MATERIALISM DEFEATED BY MAN'S DISCOVERY OF CHARACTER

In our museum halls we can actually look upon the evidence of the transition from the age of materialism to the age of conscience and character. You will find in our Egyptian Hall a group of twenty-seven statuettes with which a cemetery official who served under the shadow of the Great Pyramid nearly 5,000 years ago equipped his tomb. These painted limestone figures represent his household, his children and his servants engaged in grinding flour, mixing and baking bread, brewing beer, slaughtering cattle and poultry and cooking them, making pottery, casting metal, carrying their master's message, or with three harps and a drum, making music while he ate. Thus in the Pyramid Age, the first half of the third millennimum before Christ, the Egyptian conceived his needs in the hereafter as being purely physical gratification. Alongside the case containing these statuettes is a cedar coffin with raised lid, bearing on the inside pictures of the food and drink which carry on the old ideas of the needs of man beyond the grave. But on the inside of the lid is a long writing containing the earliest intimations that happiness in the next world will be dependent on worthy moral conduct in this world. There was a lapse of perhaps five hundred years between the cemetery official who wanted merely food and drink in the next world and the dead man who had his coffin so painted that as he lay in it and looked up at the lid, he would have staring him in the face the new fact that he might expect felicity beyond only as he had lived a worthy life here. To-day you may walk between these two cases in the museum and standing there contemplate the original evidences, the actual tokens of this supreme transition in the life of man in its rise from savagery to civilization: the first defeat of materialism—the earliest dawn of conscience, the discovery of character—the emergence of social idealism. This tremendous transition went on as a process entirely independent of religion. It transformed religion, however, for it brought forth for the first time a god of brotherly kindness. While men lived as tillers of the soil they discerned only a god of fertility; when the state arose and men caught their first vision of a supreme personality they called their god a king Then when society developed and the friction and ferment of social struggle had taught men kindness and forbearance, they saw a god of character and of brotherly kindness whom they called "the good shepherd," two thousand years before the Good Shepherd of Christian faith It was thus from the richly colored palette of human life itself that man drew the colors with which he glorified his picture of his god That splendid vision arose out of the earliest spiritual revolution. It was caught up and exalted by the Hebrew prophets and through them has brought into our lives a light which still shines from the East.

I have given you some rapid glimpses at a few of the new materials by which we have begun to bridge the gap between the emergence of physical man and the rise of Europe. It is by these researches that we are slowly creating what I have called the New Past. They form a task which must go on for centuries, and as it proceeds now and later, its results will disclose to us and to our posterity an ever clearer vision of the highest process in the universe, as far as we know it today—the unfolding life of man It is to these purposes that we dedicate this building.

THE NATIONAL ACADEMY OF SCIENCES

AWARD OF GOLD MEDALS TO DR ANNIE J CANNON AND PROFESSOR HENRY B BIGELOW

AT this year's autumn meeting of the National Academy of Sciences, held at Yale University from November 16 to 18, two gold medals were awarded. Introductory remarks by President William Wallace Campbell were as follows

The National Academy of Sciences is fortunate in possessing financial foundations for the awarding of nine gold medals and one prize, at appropriate intervals of time Two of the medals are to be presented to their recipients this evening

The Henry Draper Medal, bearing the honored name of a deceased member of the academy, was established by the widow, Mrs Henry Draper, in 1883. The committee charged with the duty of administering the Draper Foundation recently recommended to the academy, and the academy decreed, that the Henry Draper Medal be awarded to Dr Annie J. Cannon, member of the staff of the Harvard College Observatory The reasons for the selection of Miss Cannon as this year's recipient are as recorded in the committee's report to the academy In the absence of Professor Henry Norris Russell, chairman of the committee, the report will be presented by his fellow member, Director Harlow Shapley

The report was as follows

The Henry Draper Medal is awarded by the academy "for notable investigations in astronomical physics" This provision has wisely been broadly interpreted. Among the twenty investigators to whom it has been given during the last forty-five years, the majority have naturally achieved distinction through their work in the observatory—for example, Pickering and Campbell Others, like Rowland, Zeeman and the lamented Michelson, made their contributions in the laboratory, and a few, of whom Eddington is the chief, have worked in the theoretical field. Yet one characteristic is common to almost all There are not more than three of the twenty who have not, at one time or another in their scientific careers, been actively engaged with spectroscopic matters.

To-day the academy, while departing, with excellent reason, from one precedent, confirms another. For the first time the Draper Medal—and indeed any medal of the academy—is awarded to a woman; and the notable investigations in astronomical physics which abundantly justify the decision have been *par excellence* in the field of spectroscopy.

When Pickering—the second Draper Medallist—was appointed director of the Harvard College Observatory fifty years ago, he aroused the criticism of the conservatives of that day by devoting his remarkable energy and enthusiasm, and the resources of the observatory, to investigations in the physical side of astronomy.

Far from the least among these was the systematic observation and classification of stellar spectra. With a telescope affording a wide field of good definition, and having a prism placed before its objective, the spectra of hundreds of stars can be photographed simultaneously on one plate, so that there was no difficulty in securing observational material. But to record the results of investigation adequately for thousands of stars, and yet in a form not too bulky for publication, was no small problem. If stellar spectra presented the vast variety which is exhibited by living organisms the situation would be almost hopeless; but fortunately they are much less diverse. Hundreds of stars show spectra which are practically indistinguishable from one another under any ordinary dispersion, so that a relatively small number of symbols suffices for the description of the vast majority of spectra.

The Harvard observers very wisely decided to make these symbols purely formal, without any theoretical connotation Mrs. Fleming employed letters of the alphabet, Miss Maury Roman numerals Miss Cannon—our medallist of to-day—coming to her work a little later revised and refined the former system, and thirty years ago gave it the form which, with trifling changes, is now internationally adopted

It is generally known as the Draper Classification, for the work on which it was based was supported by the Henry Draper Memorial—a gift to Harvard by the widow of Dr. Henry Draper, a pioneer investigator, who obtained in 1872 the first photograph showing lines in a stellar spectrum. Our academy likewise owes the Draper Fund and Draper Medal to Mrs. Draper's generosity, and it is especially fitting that we should recognize, by the award of the Henry Draper Medal, the long and productive labors of the investigator who has done far more than all others to give the Henry Draper Memorial the distinguished place which it occupies and must permanently continue to occupy in the history of astronomy

Miss Cannon's introduction to her first "Catalogue of the Spectra of 1,122 Stars" describes the criteria upon which her classification is based so well that it has ever since been the standard authority upon the subject. No clearer statement could be made to-day of the great principle upon which the system is based —that almost all stellar spectra can be arranged in a continuous linear sequence. Though the spectra of stars near opposite ends of the sequence—for example, of Sirius and Arcturus—are so unlike that they seem at first glance to have hardly anything in common, yet a succession of stars can be found whose spectra differ from one another by barely perceptible degrees, and together form a complete transition from one to the other, and this transition is always through the same intermediate stages—there is no alternative path

The older classification had assigned letters of the alphabet to various more or less obviously different spectra, as they appeared on the photographs. The newer dropped from the list those letters which proved to correspond to poor photographs or unimportant differences, and in some cases rearranged the order to agree with that of the linear sequence whose existence had become unquestionable.

By the survival of the fittest, the letters O, B, A, F, G, K, M were left to represent standard types along the sequence. Intermediate spectra are represented in the Draper Classification by a decimal notation, B_0, B_2, B_5, B_8, B_9 being successive stages in the transition from B to A. The resulting system has proved so convenient that all it has since required is the addition of affixes to take account of certain details which had necessarily to be ignored in the pioneer work. With this admirable system at hand, our medallist faced a task which might have appalled even the stoutest heart—the observation and classification of the spectra of all the stars in the heavens which could be photographed with the instruments of the Harvard Observatory—at that time the most powerful in the world for this purpose It was no longer a question of thousands of stars, but of hundreds of thousands. The mere mechanical arrangement of the work, the identification of the stars, the recording and indexing of the observations, demanded careful planning and extensive clerical assistance

This labor of years culminated in the publication of the nine volumes of the Henry Draper Catalogue, which give the positions, magnitudes and spectra of 225,300 stars, covering the whole heavens from pole to pole, and including all the stars brighter than the 8th magnitude and many which are fainter Every one of these spectra has been examined and classified by our medallist in person. There is probably no other instance in the history of science where so great a mass of important data has been obtained by a single observer on a homogeneous and uniform system

With the completion of the great catalogue seven years ago, a less devoted observer might have felt justified in resting. But improvement in observational technique had made it possible to photograph the spectra of fainter stars, and so the "Henry Draper Extension" was begun.

This extends the observations down to magnitude 11.5, and sometimes below. The number of stars which might be observed is now so great that it is impracticable to wait until the whole heavens have been covered, and then publish a general catalogue, and the results for various regions of the sky are being published as they are obtained. About one hundred thousand spectra have already been classified, and the work still continues. Long may it prosper!

The value of these great catalogues can hardly be overstated. Knowledge of the spectral type must be obviously at the very foundation of any investigation of the colors, temperatures, real and apparent diameters and physical constitution of the stars. It has proved to be of almost equal importance to the investigators of their distances, motions and distribution in space.

Even in such an apparently local problem as the determination of the solar parallax by observations of an asteroid, the observer must know the spectra of his reference stars if he is to avoid the peculiarly troublesome errors which come from differences in color of the stars and of the planet. It is, indeed, hard to specify any branch of the study of the stars in which these great catalogues of spectra are not already almost indispensable.

With these consequences of her work—fascinating as they are—our medallist has concerned herself but little. True to the ancient tradition of the observer, who labors cheerfully for the joy of the work, and only rejoices the more that other men of different interest will enter into his labors and base their own upon them, she has used her unique skill and experience in the steady accumulation of a great addition to the permanent capital of astronomical science—a fund which, itself remaining intact, will continue to produce income in the work of astronomers yet unborn, who may well "rise up and call her blessed."

President Campbell then said:

The Agassiz Medal, awarded by the academy in recognition of valuable contributions to the science of oceanography, represents also a most commendable spirit of internationalism. The financial foundation was provided in the year 1911 by the celebrated Scotch oceanographer, Sir John Murray, in honor of his friend, Alexander Agassiz, member of the academy from 1866 until his lamented death in 1910, and president of the academy during the period 1901 to 1907. The committee on the Murray Fund recently recommended, and the academy decreed, that the Agassiz Medal be awarded to Professor Henry Bryant Bigelow, director of the Oceanographic Institution at Woods Hole. The reasons which governed the selection of Dr. Bigelow as this year's recipient of the medal will be stated, in the absence of Professor Lillie, chairman of the committee, by his fellow member, Professor George H. Parker.

Professor Parker said:

Professor Henry Bryant Bigelow, who is to receive this evening the Agassiz Medal, has only recently passed the half-century mark. He was trained in the Harvard laboratories and took his doctor's degree there in 1906, but before he had attained this distinction he had begun work on subjects dealing with the sea.

His first paper, entitled "Birds of the North-east Coast of Labrador," appeared in 1902. In the winter of 1901–02, he accompanied Mr. Alexander Agassiz on a voyage to the Maldive Islands, and in 1904 he published his report on the jelly-fishes of this expedition. In 1904–05, he again accompanied Mr. Agassiz, this time on the expedition to the eastern tropical Pacific; and in 1909 he published his very extensive report on the Medusae of this expedition, and two years later the report on the Siphonophores.

Meanwhile, through the advice of Sir John Murray, he began to take an active interest in the oceanography of the New England waters. In 1908, the U. S. Fisheries schooner *Grampus* was sent under his general management on an expedition to the Gulf Stream, a report of which he published in 1909. This initiated his extensive series of studies of the waters of the Gulf of Maine. These were made possible largely through cooperation with the U. S. Bureau of Fisheries, which repeatedly put at his disposal the use of the *Grampus*. In 1914 he reported on the oceanography of this region, and in the same year he published an account of the plankton of Massachusetts Bay. This was followed by a report on the oceanography and plankton of the waters between Nova Scotia and Chesapeake Bay. In 1917 an additional report was made on the region from Cape Cod to Halifax. Then followed the three extensive contributions of 1926 and 1927 covering the plankton of the Gulf of Maine, its dynamic oceanography and its physical oceanography. Meanwhile, in conjunction with William Welsh, he had issued his important volume on the fishes of this region. The proposal for an ice patrol as a means of greater security for shipping in the North Atlantic had been taken up by the United States Government, and, in association with Lieutenant Smith, Bigelow worked out much of the details of this organization. A report on this subject was published by him in 1929.

As work progressed the conviction grew upon him that an oceanographic institution should be started on the Atlantic coast of the United States, and he reported on this subject to the National Academy of Sciences in 1930. The material of this report was finally issued in the form of a volume entitled "Oceanography, its Scope, Problems and Economic Importance." This volume was published in 1931 and was distributed to the members of the academy. As a result of these activities the Woods Hole Oceanographic Institution was organized and a building to house it was erected near the Marine Biological Laboratory at Woods Hole and opened this past summer. Dr. Bigelow is serving as its first director.

I can not conclude this rather bare description of Bigelow's oceanographic activities without a closing note of warning. Bigelow was reputed to have been far from a diligent scholar. In his student days, one of his old teachers, long since past, took him aside, so I am informed, and told him that he would do well to withdraw from the Harvard laboratories, for he was both negligent and idle. Would that that teacher could be here this evening to face him and to tell us, who are also teachers, how easy it is to misjudge the young who come to sit at our feet. We who know Bigelow are well aware that the real salt of the sea flows in his veins and that he will devote himself to the end of his days to the promotion of oceanography.

Mr. President, your committee took the greatest pleasure in recommending to the National Academy of Sciences for the award of the Agassiz Medal Professor Henry Bryant Bigelow, associate and lifelong friend of Alexander Agassiz, and an oceanographer of the highest standing.

CENTENARY OF THE BIRTH OF OTHNIEL CHARLES MARSH

AT the dinner of the National Academy of Sciences at the New Haven meeting, Professor Charles Schuchert was called upon by President Campbell and presented the following statement and resolution.

By an odd coincidence, I was at Lockport in the western part of New York on the 29th day of last October, for the purpose of visiting the birthplace, the youthful environment and the ancestral grave of Othniel Charles Marsh. That day one hundred years ago a child was born in that village, of humble parents, Caleb Marsh and Mary Peabody, whose forebears were amongst the first settlers of old Massachusetts. This boy was destined to be for twelve years the president of our distinguished academy.

Graduating at Andover and Yale, and then spending several years at the seats of learning in Heidelberg, Breslau and Berlin, Marsh was appointed in 1866 to the chair of paleontology at Yale, the first professorship in that science in any institution. Beginning with the seventies and until the end of his life in 1899, he brought to light in rapid succession so many astonishing antediluvian animals that the unexpected became the rule with him. He revealed over and over again in complete skeletal restorations the medieval and Tertiary animals of our bad lands of the high plains. One of the strongest of personalities, Marsh in his time "stood without a peer" in his chosen field of endeavor. "To Yale he gave his services, his collections, and his estate."

At the height of Marsh's scientific career came what he regarded as the greatest honor of his life, namely, election to the presidency of this academy, and from 1883 to 1895 he served it, and through him it often became the adviser of the government in matters of a scientific nature. Over the academy he watched with as much of interest and care as over his personal affairs.

In view of these circumstances, I present the following resolution:

Resolved, That in this year which marks the centenary of the birth of Othniel Charles Marsh, and in the environment where he lived and worked so long, the academy recalls with pride the personality and mental gifts of that great paleontologist, whose distinguished service as its president was entirely in keeping with a lifetime of uninterrupted devotion to science.

In response to this resolution, Professor Richard Swann Lull spoke as follows:

Professor Marsh's birth and early training have been mentioned by Professor Schuchert. It is appropriate to express in greater degree something of his services to Yale University, especially to the Peabody Museum of Natural History with which he was so closely identified.

Coming to Yale as professor of paleontology in 1866, Marsh's services covered just a third of a century.

Inspired by a trip to the west in 1868, when he actually found a three-toed horse and is said to have discovered the first dinosaur bone found in the Rocky Mountains, he was filled with a desire to continue his search for fossils in the great west. The first formal expedition went west in 1870, and thereafter until 1873 parties, consisting largely of students or men recently graduated from Yale College and the Sheffield Scientific School, went annually to search for the scientific treasures which the region revealed. Marsh's choice of members for these parties was admirable, for almost invariably they were men who subsequently made their mark in the world, though few if any went into paleontology as a profession. Cooperation with the military authorities was obtained, and cavalry escort against the possibility of Indian attack was the usual thing. After 1873, the Indian menace becoming more acute, the student expeditions were abandoned and thereafter material was gathered by paid collectors, former guides and others, many of whom became famous in the archives of the museum. Later, as United States vertebrate paleontologist, collections were made for the U. S. Geological Survey as well as for himself and assembled here at Yale as the basis of a series of projected monographs, but two of which he lived to complete.

In 1898 Marsh's share of his collections was presented to the president and fellows of Yale, and after his death the United States material was separated out and transferred to the U. S. National Museum. His work as a collector has thus served greatly to enrich two institutions.

Not content with this, Marsh published a continuous stream of papers descriptive of the collections, and the world's knowledge of curious and bygone forms, of species and genera, families and even orders as yet unheard of was thereby vastly increased.

His anatomical knowledge was marvelous, and his paper restorations, though in but one plane of space and therefore open to possible error, became classic. To those of us who are privileged to carry on his work, the storehouse seems inexhaustible, and we are struck with the almost uncanny accuracy with which he seized upon the essentials of a new and but partially complete or developed specimen upon which to base his terse but significant description of a new species. While these descriptions, in the light of further revelation, can often be amplified, they can rarely be improved.

Then, too, as we are privileged to mount one after another of his paper-restored creatures, we are so impressed with his accuracy that if we would differ from the findings of the master, we must indeed show cause. The last of these is the magnificent specimen the mount of which is just completed. Living and dying in the Jurassic age, this monster lay entombed in Como Bluff, Wyoming, 120,000,000 years. Collected half a century ago it was sufficiently prepared to form the original type of a genus and species and to serve as the basis for the most remarkable of Marsh's restorations. Partly mounted in the old museum twenty years later, it was made the chief thing in our imagination around which the great hall of the new museum was built, and now, after fifty years, it stands again in its majesty, the fruition of the last three years of intensive work! When you go to the museum tomorrow to view its treasures which we have been privileged to display, the skeleton of *Brontosaurus excelsus* will, as the name implies, excel them all.

May I be permitted to read the tributes of two eminent men, preserved among the archives of the Peabody Museum?

To Clarence King, Director of the United States Geological Survey.

NEWPORT, Aug 19, 1876

MY DEAR SIR

In accordance with your wish, I very willingly put into writing the substance of the opinion as to the importance of Prof Marsh's collection of fossils which I expressed to you yesterday As you are aware, I devoted four or five days to the examination of the collection and was enabled by Prof. Marsh's kindness to obtain a fair conception of the whole.

I am disposed to think that whether we regard the abundance of material, the number of complete skeletons of the various species, or the extent of geological time covered by the collection, which I had the good fortune to see at New Haven, there is no collection of fossil vertebrata in existence which can be compared to it. I say this without forgetting Montmartre, Sivalik, or Pikermi.

And I think that I am quite safe in adding that no collection which has hitherto been formed approaches that made by Prof. Marsh in the completeness of the chain of evidence by which certain existing mammals are connected with their older tertiary ancestry.

It is of the highest importance to the progress of biological sciences that the publication of this evidence, accompanied by illustrations of such fulness as to enable palaeontologists to form their own judgment as to its value, should take place without delay

I am
Yours very sincerely,
(signed) THOMAS H HUXLEY

DOWN,
BECKENHAM, KENT.
RAILWAY STATION
ORPINGTON S.E.R.

Aug. 31 1880

MY DEAR PROF. MARSH·

I received some time ago your very kind note of July 28th, and yesterday the magnificent volume. (The Monograph on the Odontornithes, Extinct Toothed Birds of North America) I have looked with renewed admiration at the plates, and will soon read the text. Your work on these old birds and on the many fossil animals of N America has afforded the best support to the theory of evolution, which has appeared within the last 20 years. The general appearance of the copy which you have sent me is worthy of its contents, and I can say nothing stronger than this.

With cordial thanks, believe me
Yours very sincerely,
(signed) CHARLES DARWIN

When one bears in mind that this letter was written approximately twenty years after the publication of the "Origin of Species" we realize the fulness of Darwin's tribute to Othniel C Marsh.

SCIENTIFIC EVENTS

ECOLOGICAL NOMENCLATURE

THE following extracts from a letter to its members which was printed in the June *Bulletin of the Ecological Society of America* were intended to obtain suggestions concerning uses and abuses of ecological nomenclature which might be discussed by the newly formed committee on nomenclature and then assembled for presentation to the society at the New Orleans meetings. Knowing that many persons, not members of the Ecological Society, are actively interested in these questions, the committee believes that it may be worth while for SCIENCE to republish the essential points before the New Orleans meetings so that suggestions may be given to the committee by non-members of the Ecological Society as well as members. The committee is trying to work in the interest of all who make use of ecological terms, therefore it requests that any individual who cares to make a suggestion will give it to one of the members of the committee, preferably before the New Orleans meetings.

(1) In ecological discussions, written or spoken, what terms have you found to be used so loosely as to [illegible]

in need of better definition? At the Cleveland meeting "marsh" and "swamp" were mentioned as possible examples. Although, like many other words useful in ecology, these two often have very close resemblance (or even synonymy) in popular usage, it is possible that they could be made to indicate definite differences in practice of ecologists. The committee would like to have a list of such terms as are known to you, together with such comment as you care to make.

(2) Should the society encourage plant ecologists, animal ecologists, agronomists and other limited groups to formulate their own terminology and definitions, or should the society endeavor to help standardize ecological concepts to embrace the whole field so that all specialists, so long as their point of view is ecological, could understand all the rest?

(3) Can you suggest terms, or some usage of terms, which will help one to express the distinction between waxing and waning phases of environmental influences, *e.g.*, those involved in increasing or decreasing degrees of heat?

The committee is agreed, and probably most members of the society concur, that it is not practicable or desirable to attempt to force improvement by legislation, but it does seem possible that improvement may follow responsible suggestions and formal recommendations if they can be offered in a form suited to existing needs.

Submitted by the Committee on Nomenclature of the Ecological Society of America.

H. C. Hanson
State College, Fargo, N. Dak.
J. G. Needham
Cornell University, Ithaca, N. Y.
Walter P. Taylor
c/o University of Arizona, Tucson, Ariz.
A. G. Vestal
University of Illinois, Urbana, Ill.
W. E. Allen, *Chairman*
Scripps Institution, La Jolla, Calif.

EXHIBIT OF SPECIMENS OF HIMALAYAN FLORA AT THE ROERICH MUSEUM

An exhibition of fifty mounted botanical sheets, representing examples of the Himalayan flora, has been opened at Urusvati, Himalayan Research Institute of Roerich Museum in New York City The loan is part of a herbarium of 3,800 specimens presented to the New York Botanical Garden by the Himalayan Research Institute Headquarters in India, and has been identified personally by Dr. E. D. Merrill, director-in-chief.

The scientific value of the herbarium collections assembled by the institute, as well as the purpose of the collections, are significant. Bio-chemical and cancer research laboratories are now being built at the headquarters of the institute in the Himalayas for their investigation from a medicinal viewpoint. In this connection, also, a careful survey is being made of the Tibetan pharmacopoeia and medicinal literature. Over two hundred items, including native drugs and medicinal herbs, have already been secured, and valuable medicinal texts on therapy and pharmacology, including the *rGyud-bshi* and a number of *gter-ma* or "hidden" books on the Tibetan medicines, have been obtained. The Tibetan pharmacopoeia is known to be particularly rich, and to have in its possession, since time immemorial, remedies against cancer and tuberculosis which are said to have been used with success. It is the purpose of the institute to investigate these remedies.

The present exhibit at the Roerich Museum includes specimens of the Himalayan flora, which is a very diversified and interesting one, containing many species of marked beauty. Flowering plants, ferns and fern allies, hepatics, lichens and fungi are among the specimens represented They were secured at altitudes ranging from 5–12,000 ft elevations to the perpetual snowpeaks of Tibet, during the botanical-zoological expeditions in 1929–1931 under Dr Walter Koelz, of the staff of the institute.

The most recent explorations of Dr Koelz, during the summer of 1931, have led him into inmost Asia, through Lahul, the Indus Valley and Ladak, 26 mountain passes, some of them 18,000 to 19,000 feet, were crossed, and the expedition led past the great salt lakes of Tibet, one of them, the Pangong La, being 90 miles in length Four months were consumed by the journey. According to a preliminary report by Dr. Koelz, sent by Dr George Roerich, director of the Himalayan Research Institute, to the Roerich Museum in New York, 1,000 plant numbers (some 15,000 specimens) were obtained, and 25 big game animals—including ibex, napo, gazelle, kiang, ovis ammon, shapu, etc.—as well as a number of smaller mammals, were also collected. The report continues: "Much of the area visited has not been biologically explored previously, and in the area that has been studied ornithologically, the expedition's work has added new records to the bird fauna. None of the territory explored is under 9,500 ft. and much over 14,000 ft. . . . The vegetation is striking. Barley ripens at 15,000 ft. in places, and exquisitely fragrant, showy flowers abound on the peaks to elevations of 18,000 and 19,000 ft., these are not dwarfed, stunted plants such as one usually finds in alpine zones, but often a foot or two in height."

THE INTERNATIONAL METEOROLOGICAL ORGANIZATION

Professor C. F Marvin, chief of the U. S. Weather Bureau, has returned from Europe where he attended meetings of the International Meteorological

Organization at Locarno, Switzerland, and also the fourth general conference at Geneva, Switzerland, of the advisory and technical committee on communication and transit of the League of Nations, involving consideration and discussion of the projected matter of the reform of the calendar

According to an account in the *Official Record* the matter of first importance in connection with the meeting at Locarno was the fact that the so-called executive council, consisting of representatives of five nations, one of these representatives being the president of the International Meteorological Organization, held its first meeting after it was created at the conference of directors at Copenhagen in 1929 This was, therefore, its organization meeting In addition to deciding upon necessary rules and regulations for accomplishing the work of the council, decisions were reached in regard to the budget and funds for the maintenance of the office of the secretariat during the forthcoming year and the projects tentatively under way were approved With some modifications these rules and regulations were subsequently approved by the International Meteorological Committee, and they have now become the permanent guide for this new feature of the work of the International Meteorological Organization

The major part of the sessions of the committee was devoted to the reading of reports by the president of the Upper Air Commission, which held its meeting in Madrid recently, and the president of the Polar Year Commission, following the meeting of that and some other commissions at Innsbruck, Austria, in September The committee devoted considerable time to discussion of the numerous resolutions that resulted from the reports mentioned, and these resolutions, with such modifications as were deemed necessary, were approved or indorsed by the International Committee.

Also meetings were held of the subcommission on organization of the meteorological work of the oceans, more particularly with reference to the ship report work from selected ships on the North Atlantic. Some of the difficulties in connection with the reception and distribution of reports were discussed, and agreements were reached with a view to realizing more uniform and better and more valuable service in the future Professor Marvin reports that

> It is important to mention in this connection that almost coincidentally with these meetings at Locarno, in connection with ship reports from the oceans, an international conference of radio-marine organizations was held in New York, at which particular consideration was given to the agreement among all radio organizations to transmit meteorological reports from ships at sea free of cost for what is called the "ship tax," in view of the important benefits that navigation, including radio interests, receive from the free dissemination by meteorological services of forecasts, warnings and important meteorological information.
>
> Perhaps one of the most important actions taken at the Locarno meeting was the decision that, notwithstanding the difficulty confronting the various nations at the present time, the program of intensive observational work which had been previously planned and provided for by nearly all nations for the so-called polar year, beginning with August, 1932, and extending to August, 1933, should be carried through, although it was recognized that the critical situation might make it impracticable to carry out all the features of the program originally contemplated

THE FOURTEENTH INTERNATIONAL CONGRESS OF PHYSIOLOGY

THE Fourteenth International Congress of Physiology will be held at Rome from August 29 to September 3, 1932 The officers of the congress are Professor Filippo Bottazzi, professor of physiology in the University of Naples, *president;* Professor G Quagliariello, of the Institute of Chemical Biology at Naples, and Professor S Visco, of the Institute of General Physiology at Rome, *secretaries*

The international committee is composed of Filippo Bottazzi, Naples, who is organizing the congress; Archibald W Hill, London, Otto Frank, Munich, William H. Howell, Baltimore, John E Johansson, Stockholm, Louis Lapicque, Paris; I. P. Pawlow, Leningrad

The meetings will be held in the Institutes of Physics, Chemistry, Pharmaceutical Chemistry, Botany and General Physiology of the Royal University of Rome These institutes are within short distances of one another, in Via Panisperna 89A, and in Via Milano 71 and 75. The membership fee is 100 lire.

During the congress, besides visits to the various museums in Rome, to the Roman Forum, to the Palatine, etc., members may take part in free trips that have been provided to either Villa Adriana and Villa d'Este, or Ostia-Scavi and Ostia-Lido. After the congress, a trip to Naples with a visit to the Zoological Station, and free excursions by registered members to one of the following places will be arranged: Campi Flegrei (Solfatara) and Cuma; Vesuvius and Pompeii, Herculanum and Paestum. Those will be considered registered who have remitted the membership fee, to the following address: Presidente del Comitato organizzatore del XIV Congresso Internazionale Fisiologia, S. Andrea delle Dame, 21, Napoli (Italy).

Since a large attendance is anticipated it is necessary that each member should present one paper only. Papers not read can be published in the volume of the proceedings. Abstracts of the papers in one of the four official languages (English, French, German, Italian) must be sent to the president of the congress during the month of May (1932). Those desiring to give experimental demonstrations are requested to specify their requirements, not later than May

A list will be published in due time of the hotels in Rome and Naples with prices for board and lodging All necessary information for reserving accommodations in these hotels will be given To members coming from America, Australia, etc, information will be given in due time concerning the boats upon which passage to and from the congress may be procured. The Italian Government will grant a reduction in the prices of railway tickets from the Italian frontier or from the Italian port of landing to Rome and Naples as well as from Rome or Naples to the frontier or to the Italian port of sailing.

PRESENTATION OF A PORTRAIT OF PROFESSOR CHARLES E. MUNROE TO THE COSMOS CLUB

AN oil painting of the distinguished chemist, Professor Charles E. Munroe, of the Bureau of Mines, was presented to the Cosmos Club of Washington, D C, on December 9, by Dr Henry G Knight, chief of the U. S Bureau of Chemistry and Soils, on behalf of more than 200 friends, associates and former students of Dr. Munroe The painting, which represents Dr Munroe seated, glancing up from a manuscript which he has been reading, was the work of a Washington artist, Mr Hermann Ludden.

At the presentation exercises presided over by Dr. Knight, Dr Marcus Benjamin, of the Smithsonian Institution, and Dr Henry S. Washington, of the Geophysical Laboratory, spoke of Dr. Munroe's achievements; Dr Munroe and the artist responded, Dr. Knight presented the portrait, which was accepted for the Cosmos Club by Dr William C. White, president, and Dr Lyman J Briggs, chairman, of the art committee of the club

Dr. Munroe has been active in scientific circles in Washington for fifty years. He has been president of the Cosmos Club, the Washington Chemical Society and the American Chemical Society and is an honorary fellow of the American Institute of Chemists. For many years he was dean of the Graduate School of George Washington University and served for several years as a member of the National Research Council.

The plan to present the portrait was sponsored by a distinguished committee which included Dr. A. C Fieldner, of the Bureau of Mines, Dr. R. E. Gibson, president of the Washington Chemical Society, Dr H. G Knight, D F J. Lynch, president of the Washington Chapter of the American Institute of Chemists, former Chief Justice Walter I McCoy, president of the Harvard Club of Washington; Dr Cloyd H Marvin, president of George Washington University, and Dr H S Washington, of the Carnegie Institution Dr J F Couch acted as secretary-treasurer for the committee

SCIENTIFIC NOTES AND NEWS

DR. ALBERT EINSTEIN, of the University of Berlin, passed through the Panama Canal on December 19 on his way to California, where he plans to spend two months at the California Institute of Technology and the Mount Wilson Observatory

PROFESSOR A B. LAMB, of Harvard University, has been elected president of the American Chemical Society for 1933 The president for 1932 is Dr L V Redman, vice-president and director of research of the Bakelite Corporation, who succeeds Professor Moses Gomberg, of the University of Michigan, on January 1.

DR. IRVING LANGMUIR, of the General Electric Company at Schenectady, a former president of the American Chemical Society, was elected to honorary membership in the Chemists' Club, New York, at a meeting of its members on November 11.

THE John Scott Medals of the City of Philadelphia, for inventions in science and industry that "may add to the comfort, welfare and happiness of mankind," were presented at the recent annual meeting of the American Society of Mechanical Engineers in New York City The recipients were Albert Kingsbury, of Greenwich, Connecticut, "for the invention of a thrust bearing for use in ships and heavy machinery"; Albert H. Emery, Jr, of Stamford, Connecticut, "for the invention of the Southwark-Emery testing machine, a mechanical device for testing materials"; and Willis H Carrier, of Newark, New Jersey, "for the invention of a process and apparatus for cleaning, purifying, and humidifying the air." At the same meeting of the American Society of Mechanical Engineers Mr. Kingsbury received the society's gold medal, for research work and development in lubrication.

THE employees of the Abbott Laboratories, North Chicago, Illinois, have presented an oil portrait of himself to Alfred S Burdick, celebrating his tenth anniversary as president of the company. Resolutions signed by the 750 employees of the company were also presented to Dr. Burdick, voicing their affection and appreciation of his leadership in the ten best years of the company's history.

The *Journal* of the American Medical Association reports that in memory of Professor Arkovy, professor of stomatology in Budapest, the Hungarian Society of Stomatology has created a gold medal to be awarded every three years, by an international committee, to the stomatologist adjudged the most eminent The first award of the medal has been to Dr Chompret, stomatologist to Paris hospitals, who will retire at the end of this year from active service He was the founder and has remained the director of the principal dental school of Paris

The Mackenzie-Davidson Medal of the British Institute of Radiology and Rontgen Society was presented on the occasion of the annual dinner on December 4 to Professor Hans Holfelder, of the University of Frankfurt

At the forty-ninth meeting of the American Ornithologists Union, Joseph Grinnell, of the University of California department of zoology, was reelected to the presidency. Other officers are. A. C Bent, Taunton, Massachusetts, and J H Fleming, Toronto, *vice-presidents,* T S Palmer, Washington, D C, *secretary,* W L McAtee, Washington, D C, *treasurer* Additional members of the council are James P Chapman, Ruthven Deane, H C Oberholser, J L Peters, C W Richmond, T S Roberts and P A Taverner.

At the forty-second annual meeting of the Association of American Medical Colleges, held in New Orleans on November 30, December 1 and 2, the following officers were elected for the ensuing year. *President,* Dr Louis B Wilson, director of the Mayo Foundation of the Graduate School of the University of Minnesota, *Vice-president,* Dr H G Weiskotten, dean of the Syracuse University School of Medicine, *Secretary-treasurer,* Dr Fred C Zapffe, 25 East Washington Street, Chicago (reelected), *Members of the Executive Council,* Drs. C C Bass, Tulane University, and G Canby Robinson, Cornell University The next annual meeting will be held in Philadelphia, probably during the first week in November, 1932.

The American Pharmaceutical Association has announced as the result of the mail ballot for officers of the association, the election of the following. *President,* W Bruce Philip, San Francisco, California, now of Washington, D C, *First Vice-president,* Rowland Jones, Gettysburg, South Dakota, *Second Vice-president,* G H Frommet, Miami, Florida; *Members of the Council* (for three years), J H Beal, Camp Walton, Fla; C H. LaWall, Philadelphia, Pa, C E. Caspari, St. Louis, Mo. These officers will be installed at the next annual meeting which will be held in Toronto, from August 22 to 27, 1932. This meeting will be a joint meeting with the Canadian Pharmaceutical Association.

Dr. Edwin O Jordan, professor of bacteriology at the University of Chicago, was elected president of the Institute of Medicine of Chicago at its annual meeting on December 1, to succeed Dr Otto L. Schmidt. Dr. Arthur R. Elliott was elected vice-president, and Dr George H Coleman was reelected secretary, Dr. John Favill is treasurer and Dr. Ludvig Hektoen, chairman of the board of governors. Dr Schmidt's presidential address was entitled "The Rôle of Medical and Hygienic Museums in Education."

The New York section of the American Chemical Society has chosen Dr. Walter S Landis, vice-president of the American Cyanamid Company, as its chairman for 1932, succeeding Professor Arthur E Hill, of New York University. Professor V. K. La-Mer, of Columbia University, was named vice-chairman, and Dr David P Morgan, Jr., of Scudder, Stevens & Clark, secretary and treasurer Dr J. G. Davidson, of the Carbide and Carbon Chemicals Corporation, was named to the executive committee, other members of which are Mr J G. Detwiler, Professor Arthur E Hill and J. M. Weiss

Dr. Hugo Roesler, formerly of the University of Vienna, Austria, has been appointed assistant professor of radiology at Temple University School of Medicine, Philadelphia.

Dr. Jay Arthur Myers has been promoted from associate professor to professor of preventive medicine at the University of Minnesota School of Medicine.

Dr. Denk, who was recently appointed professor of surgery at the University of Vienna as the successor of Professor Hochenegg, took as the subject of his inaugural address "Modern Methods of Combating Cancer."

Charles Milton, Ph.D. (Johns Hopkins, '29), has been appointed geochemist and Kenneth D. Lohman, A.M. (California Institute, '30), assistant geologist in the U S. Geological Survey

Professor George W. Pierce, director of the Cruft Memorial Laboratory at Harvard University, and Professor Alfred C Lane, of Tufts College, are conducting in the Harvard physics laboratory a series of investigations to determine whether or not samples of uraninite ore mined in the Wilberforce Area, Ontario, Can, contain a sufficient amount of radium to make the ore commercially workable.

Dr. E. G. Conklin, professor of zoology, Princeton University, delivered an address on "Fitness and Fit-pose in the Living World" before the Washington Academy of Sciences on December 9

DR. WALTER S ADAMS, director of the Mount Wilson Observatory, lectured at Mount Holyoke College on December 8. His subject was "The Stars and their Motions."

DR HERBERT M. EVANS, of the department of anatomy of the University of California, delivered a lecture on "The Functions of the Anterior Hypophysis" before an open meeting of Sigma Xi at Stanford University on December 3

DR. E O ULRICH, of the U. S Geological Survey, gave a series of seven lectures on "Eopaleozoic Stratigraphy and Faunas" from December 7 to 14 in New York City The lectures were sponsored by Columbia University and the New York Academy of Sciences

DR. JOHN RATHBONE OLIVER, associate professor in the history of medicine in the Johns Hopkins University, delivered on December 14 and 15 two lectures at the Duke University School of Medicine and Hospital on "Medicine from a Historical Standpoint" and on "Greek Medicine and its Development" Dr J. W. Mayo addressed the staff and students on December 12 on "Endocrinology"

PROFESSOR ARTHUR H. COMPTON, of the University of Chicago, lectured before the Physics Club of Chicago on "Cosmic Rays and Atomic Nuclei" on December 10. This club, which was organized in Chicago last year, now has nearly two hundred members The officers are: *President,* Dean H G Gale, *Vice-president,* Professor Arthur H. Compton, *Secretary,* Burke Smith; *Treasurer,* Dr Paul E Klopsteg

THE seventh American Scientific Congress, which planned to meet in Mexico City in February, 1932, has been postponed to November, 1933

THE forty-ninth annual meeting of the American Society of Naturalists will be held on December 31 in conjunction with the meetings of the American Association for the Advancement of Science and the associated societies at New Orleans, under the presidency of Dr. S. J. Holmes, professor of zoology in the University of California. In the afternoon there will be a joint session with the Botanical Society of America and the American Society of Zoologists which will be a symposium on "The Biology of Sex" Dr C E Allen, of the University of Wisconsin, will speak on "Sex-inheritance and Sex-determination"; Dr. Emil Witschi, of the University of Iowa, on "The Physiology of Embryonic-Sex-Differentiation," and Dr H J Muller, of the University of Texas, on "Some Genetic Aspects of Sex." The regular annual dinner will be held on December 31 at 7:00 P M in the Roosevelt Hotel. It will be followed by the president's address, which will be on "The Changing Biological Effects of Interracial Competition" On December 29 at 8 30 P. M a biologists' smoker has been arranged by the local committee under the general auspices of the society. All biologists are invited to attend.

FREE public lectures on medical subjects will be given on Sunday afternoons during January, February and March at the Harvard Medical School as follows. January 3—Dr Philip Bard, "Modern Conceptions of the Brain at Work", January 10—Dr R B. Greenough, "Cancer", January 17—Dr C M Jones, "Dietary Habits in Relation to Indigestion", January 24—Dr M. I Gregersen, "The Rôle of Water in the Body", January 31—Dr. H L Blumgart, "Pneumonia", February 7—Dr. R G Hoskins, "The Glands of Internal Secretion", February 14—Dr T. M Carpenter, "Alcohol", February 21—Dr G W Holmes, "What the X-ray Can and Can Not Do", February 28—Dr T D Jones, "Rheumatic Heart Disease in Children and Adults", March 6—Dr L M S Miner, "The White House Conference and Oral Hygiene", March 13—Dr F M Rackemann, "Asthma, Hay Fever and Allied Conditions", March 20—Dr M N. Smith-Petersen, "Back Ache, Lumbago and Sacro-iliac Troubles."

THE *Journal* of the American Medical Association reports that the second International Congress of Comparative Pathology was held from October 14 to 18 at the Paris School of Medicine. The first congress was held in 1912. The war and various other circumstances intervened to prevent until this year the holding of a second congress The president of the republic and Mr Landry, minister of labor, were in attendance. An original idea, carried out by the society that organized the congress, is that its membership consists of physicians, veterinarians and botanists, so as to afford an opportunity to study pathologic problems simultaneously in man, animals and plants. The congress was attended by many foreign scientists, among others, from the United States, Drs. J R. Mohler, George W. McCoy, Milton J. Rosenau, M. B. Waite, R. L. Jones and V. A. Moore. The topics on the program were: (1) tuberculosis and vaccination, (2) brucellosis in man and in animals, (3) milk and pathogenic agents, (4) mineral deficiencies, (5) ultraviruses and (6) helminthiases.

ACCORDING to *Nature* the annual Congress of the Royal Institute of Public Health will be held in Belfast from May 10 to 15, 1932, under the presidency of the Marquess of Londonderry, chancellor of the Queen's University of Belfast. The inaugural meeting will be held on the morning of May 10, and the scientific work of the congress will be conducted in the following sections Section 1, State Medicine and Municipal Hygiene (including Port Sanitation); Section 2, Industrial Hygiene, Section 3, Women and Children and the Public Health, Section 4, Tuberculosis, Section 5, Pathology, Bacteriology and Biochemistry.

We learn from the London *Times* that the opening ceremony on November 26 of the new building for the Ramsay Memorial Laboratory of Chemical Engineering, University College, London, was performed by Prince George, who unveiled the Ramsay Memorial Tablet When the laboratory was instituted in 1923, the old parish vestry hall of St Pancras in Gordon Street was taken over, modified and equipped for temporary use, and this building is incorporated with the new laboratory in the complete scheme of the tribute to the work achieved by Sir William Ramsay during his tenure of the chair of general and inorganic chemistry at University College from 1887 to 1913 The erection of the new building was made possible by a number of leading chemical and chemical plant manufacturers, who subscribed a capital fund of £26,000 and also guaranteed an annual income of £4,000 for a number of years. The new laboratory has been planned to accommodate fifty students and research workers, and is the first of its kind in this country to be designed and erected specifically for chemical engineering teaching An important feature is an industrial laboratory for the erection, testing and operation of semi-large scale chemical plant

The recent report of the London School of Hygiene states that the school has been admitted as a school of the University of London in the faculties of medicine and science The board has approved an agreement with the Seamen's Hospital Society whereby members of the medical staff of the Hospital for Tropical Diseases form the new Division of Clinical Tropical Medicine which has been established in the school A university chair has been established in the School for Medical Industrial Psychology. Research work has continued to increase The carrying out of much research work has been made possible by grants from such bodies as the Medical Research Council, the Department of Scientific and Industrial Research, the Industrial Health Research Board, the Empire Marketing Board, and various government departments. In the past two years £1,250 has been given to the school by Imperial Chemical Industries for the purchase of special equipment in the Division of Biochemistry

Former Governor Alfred E. Smith laid the corner-stone of the Louis Marshall Memorial, the new Science Building at the New York State College of Forestry, Syracuse University, on December 4, 1931. The Board of Trustees of the College of Forestry, Chancellor Charles W. Flint, of Syracuse University, Commissioner of Education Frank P. Graves, Rabbi Benjamin Friedman and Dean Hugh P Baker participated in the ceremony. The laying of the corner-stone marked the twentieth anniversary of the college and was symbolic of the rapid growth of the institution, the physical properties of which now embrace three large buildings and approximately 7,000 acres of land

A $400,000 addition to the present quarters of the New York Academy of Medicine, Fifth Avenue and 103rd Street, made necessary by the increased needs and steady expansion of the organization, has been announced A gift of $350,000 toward the building by Mr. Edward S Harkness was announced at the same time The new structure, to be of six stories, will be built on one of the three adjoining lots on East 103d Street and over the auditorium. When the present building was planned seven years ago, provision was made for additional stories to be built as the need arose, and it is expected eventually to continue the building eastward on the two other lots. Mr Harkness made his gift on the condition that the academy raise a $400,000 endowment. This has already been done and $11,000 has been raised toward the academy's share of the new addition. The façade of the addition will be of stone for the lower three stories, and brick with stone trimmings and corners for the upper three stories Additional facilities will now be provided for the library, particularly for the care and study of the books on historical medicine; a seminar room for teaching historical medicine; space for the care of portraits and engravings on medical subjects; a larger committee room and exhibition space

The Department of Geology of the University of Vermont will install a two component Milne-Shaw seismograph, to be operated in connection with the new Robert Hull Fleming Museum. A grant for this purpose has been made by the National Research Council, and it is hoped to have the instruments in operation by the fall of 1932 Seismograph stations in the northeastern part of North America are in operation at New Haven, Cambridge, Halifax, Ottawa, Buffalo and New York City It is believed that the addition to this network of a station at Burlington will be of considerable value.

The British Museum (Natural History) has given £2,000 to the University of Cambridge for the use of the Scott Polar Research Institute. The sum represents part of the unspent balance of a fund which was subscribed to meet the cost of working on the collections and publishing the scientific results of Captain Scott's "Terra Nova" expedition.

The contributions from the Boyce Thompson Institute for Plant Research, Yonkers, New York, dealing with all phases of plant research, which formerly were issued only as reprints from other journals, are now published from the institute only and collected in yearly volumes of not less than five hundred pages. Subscribers will also receive reprints of the professional papers dealing usually with practical applications of the research work. Persons carrying on investigations or teaching along the lines discussed will be placed on a mailing list for notices of publications as issued, and furnished with copies on request. Others may purchase such reprints.

DISCUSSION

GAMBUSIA IN FOREIGN LANDS

In about 1920, apropos of the successful use of Gambusia for the control of mosquito breeding in the extra cantonment zone of a U. S. Army camp in 1918, the International Red Cross made an appeal through diplomatic channels to the Bureau of Fisheries for broodstocks of this fish for Italy and Spain. The shipment that went forward to Italy was a failure, very probably due to improper care of the fish while en route. However, the fish sent to Spain arrived in fairly good condition. A rapid multiplication appears to have taken place, and within a year or so Italy was able to obtain a broodstock from Spain.

In a paper entitled "Recent Developments in the Control of Malaria"[1] given before the National Malaria Committee (conference on malaria at Louisville, Kentucky, November, 1930) by Dr. L. W. Hackett, of the Rockefeller Foundation, who had been stationed in Italy, collaborating with the Italian National Health Department, stated that the introduction of Gambusia into Italy led to unexpected results. He points out that multiplication was unusually rapid and the density of the Gambusia population in some localities apparently now exceeds that of the most favorable places in our Southern states. Standing water in some sections has become fairly clogged with the fish, so much so that the peasants complain that the cattle refuse to drink the water. To illustrate the density of the fish population, Dr. Hackett says:

> From one lime sink in Istria about an acre in extent we took over four million Gambusia for distribution purposes last year without apparently diminishing the number per unit of area. No horizontal vegetation, however thick, can protect anophelene larvae from the fish, large and small, which constantly patrol every square inch of water surface. In the area of about eight square miles which we have had under observation for five years in Istria, the spleen index in a scattered rural population has gone down from 98 per cent. in 1924 to about 10 per cent. in 1930.

(It may be explained here that malaria causes the spleen to become enlarged and the examination of people, especially school children, for enlarged spleens is a common method of determining the prevalence of malaria in a community.)

In regard to the effectiveness of Gambusia for the control of malaria in the area referred to in the preceding paragraph, Dr. Hackett says:

> Acute epidemic malaria is reduced to sporadic cases, and a tuberculosis preventorium for Viennese children can now be operated throughout the year instead of being closed from June to October. There has been no case of malaria among the 300 children in the last two years. Nothing but Gambusia distribution has been done in this area.

Although Gambusia is very effective in standing water, Dr. Hackett points out that in Italy *Anopheles maculipennis*, an efficient vector of malaria, breeds along the edges of running streams, and for the eradication of this mosquito the fish have not been successful, since Gambusia, as is well known, does not frequent running water.

It is understood that Gambusia has been distributed, from the original introduction into Spain, to nearly all countries of Europe from Germany and Austria southward. The results claimed for Gambusia in southern Europe, and especially in Italy, as an eradicator of mosquito larvae far exceed those secured in this country.

The great value of Gambusia as an eradicator of the aquatic stages of the mosquito was first clearly shown in the wide use made of the fish in the extra cantonement zone of Camp Hancock at Augusta, Georgia, in 1918.[2] Other studies were undertaken after this investigation was completed and the results published, and the great value of Gambusia as an agent for the control of mosquitoes and malaria became definitely established. Various prior claims were made for Gambusia and other small fish as eradicators of mosquito larvae, but they were not based on well-founded or extensive evidence. In an effort to secure an enemy of the mosquito which will work every day in the year without cost or care, Gambusia has been introduced, not only into southern Europe, but also into Palestine, the Philippine Islands (from whence it is reported to have reached China and Japan), the Hawaiian Islands, the West Indies and the Argentine

---

[1] *Journal Southern Medical Association*, xxiv 5, pp 426–430, May, 1931.

[2] "Fishes in Relation to Mosquito Control in Ponds," by Samuel F. Hildebrand. U. S. Public Health Reports, May 23, 1919, pp. 1113–1128, 3 double pls., 3 figs. Reprint No. 527. Also Appendix IX, Report, U. S. Commissioner of Fisheries, 1918 (1920), 16 pp. Pls. I–VI, 3 figs. Bureau of Fisheries Document No. 874.

Gambusia apparently did not multiply as rapidly or become as numerous in other localities where it was introduced as it did in Italy However, it generally multiplied and spread In Palestine alone it appears to have met enemies with which it could not cope successfully Often Gambusia spread far and wide from the place of introduction, as already indicated, until it has become almost cosmopolitan in the warmer sections of the world.

SAMUEL F. HILDEBRAND

BUREAU OF FISHERIES,
WASHINGTON, D C

THE COMMON EARTHWORM AS A SERIOUS ECONOMIC PROBLEM

ORDINARILY the common earthworm is thought of as being a valuable adjunct to the fertility of the soil. Under ordinary conditions this is generally true. However, a condition has come to my notice in which just the reverse is the case

A few weeks ago a rancher from one of the lower mountain valleys came into my office with the following story From the main canal, a ditch about a mile and a third in length leads to his ranch This supply ditch skirts the base of a hill which is largely clothed with scrub oak. Consequently, conditions bordering the ditch are ideal for earthworms, because the soil contains large quantities of humus. Organic matter is abundant.

The whole problem is that the soil bordering the ditch is so riddled with the burrows of earthworms that it is almost impossible to get water through the ditch with which to irrigate the fields of the ranch. The soil bordering the ditch is so porous that the greater part of the water seeps away and is lost. This is a serious condition, and, in years of a scarcity of water, it becomes doubly serious. The rancher was seeking a remedy, for his ranch threatened to become valueless as a result of this condition

So far as the writer is aware this problem is unique. No precedent was available upon which to base a definite answer to the rancher. However, it was suggested that the ditch be shut down and copper sulphate be used to poison the worms Copper sulphate can be dropped, a handful about every three or four feet in the standing water in the ditch When the water shall have all soaked into the soil, the ditch could be opened up again

If the worms are to be poisoned they must be poisoned by a method that will be harmless to live-stock, since live-stock use the water of the ditch for drinking purposes. It seems that the copper sulphate method is the least likely to be dangerous. Some work done by the writer in former years[1] seems to indicate that this chemical, over a short period of time, will result in no harm to vertebrates

In the West, in virgin desert soil, so far as the writer is able to determine, earthworms do not occur. They become established only when dry land is brought under irrigation In some sections of the West, if not most sections, irrigation has not been practiced for very long, comparatively speaking. Consequently, earthworms are just now beginning to be present in really considerable numbers. In fields and pastures generally they are valuable adjuncts to the fertility of the soil, but, in situations such as the above described, they may be a serious pest In the future they may become more of a pest and a source of serious economic loss However, it is believed that copper sulphate, a cheap chemical, may be the solution to such problems

Another solution would be to concrete the supply ditch; but this is an expensive proposition. To build a wooden flume would also be expensive. As a temporary measure, the rancher in question used tarred roofing paper, folded into the ditch, as a relief measure This latter worked, but it is obviously only a purely temporary way to solve the problem.

The writer has in his own flower garden a short row of sweet peas that it is impossible to water with the hose from the city water supply, when the hose is allowed to run a fair stream with the nozzle placed in a tin tomato can at the head of the row. This is due to the burrows of earthworms draining away all the water Consequently all watering of these flowers is now done by surface sprinkling

Water is all-important in the West. Those that are well informed know the careful attention that is given to reclamation and to conservation of the water supply in the western United States. Any waste of water is serious, and a direct economic issue. With regard to the problem as above stated, further research is to be undertaken by this laboratory and it is hoped that a solution may be reached.

C. T. HURST

WESTERN STATE COLLEGE OF COLORADO

CONICAL HAILSTONES

Two interesting descriptions of conical snowflakes have recently appeared in SCIENCE[2], one by Mr. A. D. Moore and one by Mr W W Wagener. It is never easy for an author to feel sure that he has examined all the literature, and it may therefore be worth while to call attention to two papers on a similar subject written between fifty and sixty years ago by Osborne Reynolds[1].

---

[1] C T Hurst, "The Effects of Solutions of Copper Sulphate on Ducks," *Arch. Path. and Lab. Med.*, [illegible].

[2] A. D Moore, SCIENCE, 73: 642 (June 12, 1931); Willis W Wagener, SCIENCE, 74: 414 (October 23, 1931).

The papers by Reynolds deal with the manner in which raindrops, snowflakes and hailstones are formed. Concerning the shape of a hailstone he says: "Although to the casual observer hailstones may appear to have no particular shape except that of more or less imperfect spheres, on closer inspection they are seen all to partake more or less of a conical form with a rounded base like a sector of a sphere. In texture they have the appearance of an aggregation of minute particles of ice fitting closely together, but without any crystallization such as that seen in the snowflake—although the surface of the cone is striated, the striae radiating from the vertex." This description is similar to those given by Mr. Moore and Mr. Wagener for the snowflakes which they observed.

Reynolds made some experimental studies in which he obtained imitation hailstones of this shape, but in connection with real hailstones he says: "When found on the ground the hailstones are generally imperfect." Perhaps this imperfection is one reason why the conical form is not observed more frequently.

Arthur Taber Jones

Smith College

THE SCHOOL DAYS OF LORENTZ

I am not sure how generally known it is among scientists in this country that on September 9 last a monument to Hendrik Antoon Lorentz was unveiled in the Sonsbeekpark in Arnhem by Princess Juliana of the Netherlands. In connection with this event, one of Lorentz's early school friends published in the *Haagsche Post* for September 5 some recollections of many years ago. Thinking that a good many readers of Science may be interested in anecdotes concerning Lorentz, I am sending herewith a free translation of some of the stories told in this article.

I made the acquaintance of Lorentz in the days when the boiling of a kettle of water in the early morning hours was troublesome for the housewife; it could be bought for a penny and a half in one of the neighboring shops.

Soon after I had come to live in the street where Lorentz's father kept a grocery, each of us was sent to fetch hot water. As customary among boys who meet for the first time, we had to make acquaintance by means of a fight; and I was quite ready for a good working out, but did not get that far. Even in his early years Hentje Lorentz was of a peace-loving nature, besides he showed his powers for logical thinking. I can still hear him say, "Don't you think we had better postpone the fight until another time? Fighting is dangerous when you are carrying a kettle of boiling water; for burns leave permanent scars." I had lost my desire to fight and we walked home the best possible friends.

From a later period: One of the three teachers in our school used to lecture occasionally on scientific subjects. For these lectures he needed drawings. Drawing was my one accomplishment. The strange thing happened that I was frequently punished a few days before a lecture was to take place. The punishment consisted of having to draw physical apparatus with white chalk on blue paper. One day there was apparently so much work to be done that one boy could not get it completed in time. To the great astonishment and indignation of the entire school, Lorentz was also punished on that day, no one knew why. So that afternoon, Hentje and I sat bent over large sheets of blue paper. During our work he explained to me the principles underlying the various instruments that we had to draw. To him everything was as clear as crystal, I did not understand much about it and did not know where he got all the information, thinking at first that he was fooling me. All of a sudden our teacher came in, probably having heard a good part of the lecture Lorentz had given me, for he patted him on the back and said: "What brains! There is not very much I can teach you about this subject any more." Among the boys of our acquaintance it was the common conviction that Lorentz knew everything.

From his early manhood. One day I nearly burst with laughing for I met Hentje wearing a full, black beard; he was then nineteen years old. When I expressed my astonishment at this remarkable adornment of his chin, he answered, "I have been appointed teacher in one of the evening schools; this beard will support my prestige." His good-hearted, intelligent eyes showed the same twinkle that always characterized him in boyhood.

Arnold Dresden

Swarthmore College

THE WORK OF DR. BASKERVILLE

In the issue of Science for October 30, Dr. Carmichael is credited (p. 422) with the following statement concerning the work of the late Dr. Charles Baskerville: "He discovered the chemical elements, carolinium and berzelium."

This is obviously a slip, as no such elements are recognized by chemists. Dr. Baskerville, with whom I had the honor to be associated for four years, did tentatively announce the discovery of substances which he designated as carolinium and berzelium. The announcement was premature, and I am certain that he regretted it. The literature records many similar occurrences, and this does not in any way detract from the high opinion which Dr. Carmichael holds concerning Dr. Baskerville, who was not only a brilliant research chemist but a man whose kindliness and stimulating personality endeared him to his colleagues.

Nathan Van Patten

Stanford University

---

[1] Osborne Reynolds, Lit. and Phil. Soc. Manchester, Memoirs, Vol. 6 (1876–77 and 1877–78). Reprinted in the Scientific Papers of Osborne Reynolds, Vol. 1, 214, [illegible]

THE TERM PROTEIN

The article on "The Revolt of the Biochemists" by me published July 10th in Science contained the following statement:

> In 1860 the term "protein" was introduced by Mulder .

It should read:

> In 1839 .

The author overlooked the error and is indebted to Professor Lafayette B. Mendel for having called his attention to it

P. A. Levene

SPECIAL CORRESPONDENCE

TWENTY-SEVENTH ANNUAL NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

The twenty-seventh annual New England Intercollegiate Geological Excursion was held at Montreal from October 10 to 12 Approximately fifty members attended and the following institutions were represented Colby, Columbia, Dartmouth, Harvard, Massachusetts Institute of Technology, Massachusetts State College, Massachusetts State Normal School, McGill, Mt Holyoke, New Hampshire, Tufts, Syracuse, Union, Vermont, Quebec Bureau of Mines, and the Geological Survey of Canada.

On Saturday morning Professor J. J. O'Neil led the party on a trip to the agglomerate on St Helen's Island. The agglomerate is intrusive into the Utica shale, outcrops of which may be seen on the south end of the island. The fragments in the breccia are sub-angular and consist of Pre-Cambrian gneiss, Potsdam sandstone, Utica shale, and various limestones. The blocks average three inches in diameter, but many are much larger and a few measure scores of feet across Perhaps the most interesting inclusions are the large blocks of limestone exposed on the northeast end of the island, for they contain Lower Devonian fossils The ground mass of the agglomerate is highly altered, but contains apatite, perovskite, pyrite, hydronephelite, epidote, abundant carbonates, and doubtful melilite. It is probably alnoite or camptonite

The afternoon excursion, a trip over Mount Royal on foot, was led by J. J O'Neil, J E Gill and F. F. Osborne The party climbed up the east slope of the mountain, which rises directly west of McGill University. The first outcrops studied were Trenton limestone cut by a variety of dikes and sills. Higher up on the mountain is a small belt of Utica shale, altered to a compact hornfels. The next stop was at the coarse essexite just below The Lookout From The Lookout one may make an excellent survey of the St. Lawrence Lowland, which lies about one hundred feet above sea-level. Extending east from Montreal are the Monteregian Hills, the elevations of which vary from 715 feet to 1,755 feet. They are intrusions of alkaline rocks similar to Mount Royal. Still further to the east and southeast are the Green Mountains. Slightly east of south is the Champlain Lowland and somewhat west of south are the Adirondacks

From The Lookout the party proceeded to the raised beaches on the south side of Mount Royal. These beaches indicate the upper marine limit of the Champlain sea at the close of the Pleistocene, the highest stands at about 575 feet The last stop was in a large quarry on the west slope of the mountain, where marmorized and squeezed Trenton limestone is intruded by nepheline syenite and basic dikes and sills. It is clear that considerable flowage of the marble has occurred since the intrusion of the dikes and sills, for the latter are crumpled and sheared

In the evening the group gathered at the McGill Union for brief talks on the trips to be held on Sunday and Monday. Refreshments were then served and the meeting broke up into small groups for informal discussions.

On Sunday Professors J. J. O'Neil, F F. Osborne and R P D Graham led the main party on an auto trip of one hundred and fifty miles to the Morin anorthosite area in the Laurentian Mountains. Unfortunately it rained most of the day Nevertheless the party saw a variety of Pre-Cambrian rocks, including Laurentian gneiss, Grenville limestone and Morin anorthosite. At the Ivry mine there is an interesting area of ilmenite and anorthosite. Dr. Osborne considers the ilmenite to be an intrusion into the anorthosite.

On the same day Dr. H. W. McGerrigle guided a small party studying the stratigraphy of the Lower Paleozoic rocks around Montreal. The Island of Montreal and the St. Lawrence Lowland are underlain by Upper Cambrian and Ordovician strata dipping very gently to the southeast and resting upon a Pre-Cambrian basement, which is found in wells 2,500 feet below Montreal. The Potsdam sandstone, Beauharnois dolomite, Lowville limestone, Black River limestone, Chazy limestone, Utica shale and Lorraine shale were all studied.

On Monday the entire party, guided by Dr. H. W. McGerrigle, studied the structure and stratigraphy of the overthrust sheets of Lower Paleozoic limestones in the vicinity of Philipsburg, P. Q. One stop was along the shore of Missisquoi Bay, where the Champlain thrust may be seen The Rock River dolomite, of Lower Ozarkian age and belonging to the Philipsburg thrust block, rests on the Utica shale, of Upper Ordovician age and belonging to the foreland Another stop was at the quarry of the Philipsburg Marble Company, where the Strites Pond and Wallace Creek formations, both of Upper Ozarkian age, may be seen

Considerable time was spent on the Naylor Ledge and Luke Hill formations, the relations of which have been a subject of controversy[1] between Dr McGerrigle and Dr. Ulrich. The party agreed with Dr. McGerrigle that the physical evidence disproved Dr. Ulrich's cave hypothesis.

Some of the most interesting exposures were those seen one and a half miles north of St Armand, for they show the tremendous brecciation at the base of the St Armand thrust sheet.

The party deeply regretted that illness prevented the attendance of two of its members, Dr T H Clark, of McGill, who had organized the excursion, and Dr. W G Foye, faithful secretary of the excursion for many years

Marland Billings

Harvard University

REPORTS

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES, 1930–31

The Research Information Service of the National Research Council, with the cooperation of the registrars of the various American universities, is again able to present information regarding the doctorates in science.

The following data for the academic year 1930–31 supplement the data in Science 72 357–358 (1930), where a survey is given of the data for the period 1898–1930

Detailed data for the year 1930–31, with comparative statistics for the past ten years and with the names of the recipients of the degrees and the titles of the theses, will be found in Reprint and Circular Series numbers 75, 80, 86, 91 and 95 Copies of these may be obtained from the Publication Office, National Research Council, Washington, D C.

Clarence J West
Callie Hull

TABLE I

Doctorates Conferred according to Subjects

	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31
Chemistry	150	185	251	250	257	270	278	312	317	392
Zoology	39	45	42	71	55	70	89	91	102	117
Psychology	32	46	51	51	60	74	66	112	97	105
Physics	57	54	58	59	76	92	78	101	91	93
Botany	37	64	57	69	69	53	61	76	81	81
Mathematics	20	28	32	24	47	46	44	61	75	78
Physiology	18	20	17	17	43	35	28	37	46	46
Agriculture	9	10	11	16	19	19	31	27	29	45
Geology	22	34	41	25	27	42	35	45	63	39
Bacteriology	15	32	12	20	21	20	30	26	27	38
Pathology	27	21	12	5	4	16	31	27	31	26
Engineering	4	5	5	2	11	10	28	34	49	25
Public Health					3	4	4	15	8	20
Anatomy	5	10	5	4	11	13	12	15	12	11
Astronomy	4	6	7	3	7	9	3	8	4	11
Anthropology	0	3	3	2	5	3	5	13	6	7
Geography	3	7	3	13	11	14	7	12	17	6
Metallurgy	1	2	2	3	10	4	13	8	4	5
Paleontology	1	2	2	1	7	0	1	2	6	3
Archaeology	0	0	0	0	0	0	0	2	2	2
Med. & Surg.				-	-	-	-	-	4	2
Mineralogy	0	1	1	4	4	2	0	1	3	1
Meteorology	2	0	0	0	0	0	0	2	0	0
Totals	455	575	611	640	748	796	844	1027	1074	1148

---

[1] H. W. McGerrigle, "Philipsburg Series of Southern Quebec." *Bull Geol Soc. America*, 42, 347–348, 1931 (abstract); E O Ulrich, "Naylor Ledge, A Marine Limestone of Canadian Age Filling Caverns in Upper Ozarkian Formations" (abstract). *Ibid.*, p. 348.

TABLE II

Doctorates Conferred according to Universities

	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31
Wisconsin	32	44	41	64	53	55	60	66	86	86
Chicago	61	71	75	59	78	86	70	99	94	82
Ohio State	18	21	20	33	25	30	25	48	50	74
Johns Hopkins	28	58	44	36	50	44	56	62	58	67
Cornell	36	41	60	39	43	62	67	60	80	57
Michigan	20	15	25	15	32	30	52	38	55	55
Yale	22	34	22	41	38	34	38	47	43	53
Columbia	31	58	57	51	49	62	46	61	44	51
Harvard	21	31	35	25	35	42	33	40	40	49
California	24	27	20	31	38	42	37	50	47	48
Minnesota	16	17	23	23	30	29	41	53	53	47
Illinois	28	33	20	32	44	31	36	34	43	45
Iowa State			9	12	14	13	26	28	26	39
Iowa	12	12	16	19	28	24	32	38	28	34
Stanford	7	8	14	15	17	17	17	26	26	28
Calif. Inst.	2	0	9	8	15	8	18	22	18	23
New York	3	10	2	5	7	4	11	13	10	23
Pennsylvania	9	8	12	12	14	27	18	24	26	19
Mass. Inst.	8	11	18	18	13	18	13	20	29	16
Princeton	12	9	17	15	12	18	17	25	22	16
Pittsburgh	7	7	5	8	7	11	13	8	15	15
Cincinnati	5	3	4	7	8	5	1	14	6	13
Northwestern	7	2	6	2	4	6	8	5	8	13
Maryland	0	0	1	5	6	3	6	8	3	12
North Carolina	1	2	1	0	7	3	4	3	6	12
Missouri	4	0	5	4	3	7	2	3	6	9
Virginia	2	1	3	5	5	8	3	5	12	9
Western Reserve		–						3	5	9
Mich. State	0	0	0	1	4	2	2	6	2	8
Penn State	–	–				1	4	3	3	8
Wash. St. Louis	2	8	2	0	5	7	2	7	7	8
Brown	3	3	3	8	4	4	5	7	9	7
Catholic	0	1	3	3	6	5	8	6	2	7
Indiana	3	5	5	8	7	5	8	9	11	7
Nebraska	2	2	5	7	2	2	3	4	6	7
Purdue				–			1	0	4	6
Washington	2	0	1	3	1	1	5	8	6	6
Duke	–	–	–				–	4	4	5
Kansas	0	2	2	4	8	8	5	10	11	5
Rice	1	0	1	2	1	1	3	4	3	5
Rochester	–	–	–	1	0	3	3	0	2	5
Rutgers	–	–		–	2	3	9	4	5	5
Texas	0	1	0	0	1	3	0	7	6	5
Clark	6	8	3	6	7	7	5	11	11	4
Fordham	2	2	0	2	2	1	2	8	6	4
Mass. State	2	1	1	0	1	0	1	1	3	4
Rensselaer	1	0	2	0	2	2	7	3	2	4
St. Louis			–	–		2	3	2	3	4
American	–				3	3	3	1	3	3
George Peabody	–		–			–		–	–	3
Geo. Washington	8	13	5	6	4	4	2	5	2	3
Wash. State			–	–	–	–		–	1	3
Vanderbilt				–	–		2	2	0	3
Colorado	1	1	0	1	3	1	3	3	2	3
Georgetown			–	–			–	1	0	2
Notre Dame	0	1	2	0	0	0	0	1	3	2
Radcliffe	3	3	2	3	3	2	1	2	5	2
Arizona			–	–	–	1	0	0	0	1
Bryn Mawr	7	0	1	1	2	4	0	1	2	1
Marquette	–		–	–			1	0	0	1
N. Y. Forestry	–		–	–	1	1	2	2	0	1
Oregon		–			1	0	0	0	2	1
Syracuse	1	0	0	0	2	3	2	1	2	1
Boston	0	1	0	0	1	0	0	0	2	0
Tulane	–	–			–	1	3	1	1	0
Totals	455	575	611	640	748	796	844	1027	1074	1148

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF MICRO-MANIPULATORS

Some interesting variations in the use of the micro-manipulator have induced me to call attention to a point in its historical development. I developed a micro-manipulator in 1905[1] at the University of Pennsylvania for the purpose of dissecting the egg cases of certain animals and orienting the eggs in such a way as to be able to work out the cell lineage, and used the same apparatus for removing chromosomes from eggs. Since these eggs are heavy and would fall to the air-water surface of a hanging drop and be burst by surface tension effects, it was necessary to work from above even though the air-water surface might produce optical distortions while making the observations. A slightly modified micro-manipulator was used in cutting and stimulating protozoa.[2] This work was done entirely independently of the Barber pipette holder which was developed in Kansas simultaneously. I did not hear of the Barber pipette holder until many years later when it was developed by Chambers and others, who found it preferable to work in hanging drops More recently Richards[3] has developed an instrument for working above the slide and McNeil and Gullberg[4] have described a similar instrument As to the virtues of these different types, the rack and pinion used by myself gives very rapid manipulation at low powers of the binocular microscope. I used also a micrometer screw, working against a spring This type gives a slower motion but if it guides a square tube sliding upon a square rod, there is liable to be some lost motion at right angles to the action of the spring unless further springs are used to tighten the bearings This micrometer arrangement, as well as rack and pinion for rapid motion, is used by Richards McNeil and Gullberg used the hinged joint as developed by Chambers. It seems possible that the hinged joint acting against a spring may be preferable for movements of short distances. More extensive movements would be complicated by the fact that the movement is in the arc of a circle and not in a straight line.

In my micro-manipulator, movement in the three dimensions was obtained by actuating three knurled heads side by side in the same plane and it was intended to develop reflexes by which movement in any direction could be performed by the fingers of one hand. A long period of education is necessary and it seems probable that a micro-manipulator made on the principle of the pantograph would be preferable in that time required to develop these reflexes would be saved.

J. F. McClendon

University of Minnesota

RAPIDLY RIPENED HAEMATOXYLIN AND ITS USES

Kohl and James[1] have recently presented a rapid method for the ripening of haematoxylin in solutions by exposure to a powerful quartz mercury vapor light The writer for several years has been using, with considerable success, another method suggested by Miss Ethel Thomas, of the Thomas Biological Supply Company, Charleston, Ill. The method applies principally to the ripening of the haematoxylin for Heidenhain's iron-alum stain, but may be adapted to other haematoxylin stains It consists of merely adding the haematoxylin crystals (sufficient to make a one half per cent solution) to boiling distilled water In making the solution the writer has found it best to bring the water to a vigorous boil The fire is turned off and the crystals added before bubbling completely ceases. A sufficiently large container should be used so that the solution does not overflow during the effervescence accompanying mixing The solution may be used as soon as cool, but is a little better if permitted to stand a few hours. It changes but little after several weeks in a flask with only a loose cotton plug

In use, material to be stained is treated according to the usual Heidenhain method, with the exception that the writer uses intensifiers which have proved to be advantageous, although they may be omitted, the results being comparable to the usual ones with this method

In intensifying the stain the material is removed from the haematoxylin, rinsed in distilled water and destained in 2 per cent, iron-alum until all undesirable precipitates are removed and the intensity of the stain is below that desired in the finished preparation The material is then rinsed for one to three hours or even longer in two to six changes of distilled water. After the material is thoroughly rinsed to remove all traces of iron-alum, the stain is then intensified by immersion in a weak solution of sodium acid carbonate, magnesium carbonate, or lithium carbonate, until it assumes the desired intensity. In this way a greater degree of differentiation is attained than by the ordinary method. The writer has found lithium carbonate more satisfactory than sodium acid carbonate. Magnesium carbonate has not been used on a sufficient variety of material for its value to be estimated, although where it has been used it has given satisfactory results

---

[1] *Biological Bulletin*, 12: 141, 1907.

[2] *Journal of Experimental Zoology*, 6: 87, 1909.

[3] *Journal of Biological Chemistry*, 87: 463, 1930

[4] Science, 74: 469, 1931.

[1] E. J Kohl, C M James, "A Method for Ripening Haematoxylin Solutions Rapidly," Science, 74: 247, 1931

W H Camp

The Ohio State University

HEAVY GLASSWARE IN THE LABORATORY

This note was suggested by that of Dr J Howard Brown who recently described in these columns the use of milk bottles with a crown seal for bacteriological laboratory purposes In the laboratory with which the writers are connected the replacement of the fragile and expensive laboratory glassware by heavy or commercial products has been constantly increasing The type commonly known as a prescription bottle, in the 6 oz. and 12 oz sizes, has been found particularly desirable The modern heavy glass bottle is so well annealed that it will stand repeated heatings in the autoclave with no clouding of the glass and with a negligible amount of breakage

Instead of the crown seal, we have used the screw cap seal with excellent results The screw caps can be obtained with various types of liners, of which the cardboard-waxed paper combination has proved the best Such caps can be placed on loosely in situations where ventilation is desired For many purposes an unlined cap is best It permits of practically no evaporation on long storage and the closure is sufficient to prevent all contamination The easy removal of the screw cap and its re-use an indefinite number of times is an advantage over the crown seal

A prescription bottle, which has one side nearly flat, is used in this laboratory for a variety of purposes It serves admirably for the storage of bacteriological media, for the water used as dilution blanks in quantitative bacteriological work, and in many instances in place of the familiar petri dish. About 15–20 cc of agar is sterilized in the bottle, which is placed with the flat side down for the agar to harden, when the bottle is used in place of a petri dish. When used in the student laboratories in place of the petri dish for isolation purposes or for quantitative work, there is less difficulty from contamination and much less desiccation of the agar than with the petri dish

The screw cap when placed loosely on the bottle permits of sufficient diffusion of oxygen to support the growth of the obligate aerobic organisms and serves to keep out contamination as well if not better than a cotton plug In moist situations there is no danger of molds growing through the seal as often occurs with cotton plugs

These bottles are very satisfactory for the growth of mass cultures of bacteria for the preparation of vaccines and antigens During the past three years many thousand cultures of the legume-nodule bacteria have been grown and distributed to the farmers of the state in such bottles Before the adoption of the screw cap, bottles with cork finish were used The cork-finish bottles were plugged with cotton during the incubation period and this cotton plug was replaced with a paraffined cork for shipment. With the screw-cap bottle, the cap is placed on loosely during the incubation period and then tightened for shipment. The use of the screw cap has materially lessened the labor of preparation and has actually resulted in a lower percentage of contamination The inoculation of the agar for these cultures is done by a spray process similar to that employed in applying lacquer or paint An ordinary atomizer with supply pipe dipping into a suspension of the inoculant is supplied with compressed air which passes through a sterile three-foot length of 2 inch iron pipe which is packed with cotton Two men can easily inoculate 800 bottles an hour with this apparatus

E G. Hastings
I L Baldwin

University of Wisconsin

SPECIAL ARTICLES

A PRELIMINARY NOTE ON THE SIGNIFICANCE OF THE PHOSPHORUS INTAKE IN THE DIET AND BLOOD PHOSPHORUS CONCENTRATION, IN THE EXPERIMENTAL PRODUCTION OF CARIES-IMMUNITY AND CARIES-SUSCEPTIBILITY IN THE RAT[1]

Introduction

Recently Hoppert, Webber and Canniff[2] have reported that rats fed stock diets develop caries[3] of the molars at three months of age The composition of the stock diet as published consists of whole ground corn 60 parts, whole milk powder 30 parts, linseed oil 6 parts, alfalfa 3 parts and sodium chloride 1 part.

When the 60 parts of corn were omitted from the diet and replaced by either 60 parts of oatmeal or 60 parts of that portion of whole ground corn which passes through a sixty-mesh sieve, no caries were observed in the experimental rats. These workers conclude or suggest that the higher incidence of caries on the diet containing 60 parts whole ground corn is due to the impaction in the molars of large particles of corn, resulting in fermentative processes, so giving rise to dissolution of tooth substance This deleterious effect on the teeth, they report, is prevented by substituting in the diet 60 parts of that portion of whole ground corn which passes through a sixty-mesh screen

---

[1] The Biochemical Laboratory, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Maryland

[2] C. A Hoppert, P A. Webber and T. L. Canniff, Science, 74 77, July 17, 1931.

[3] Dental caries in the rat means a breaking down of tooth structure in the molars of rats resulting in a cavity formation such as has been described in a previous communication (H. Klein, *J. Dental Research*, 11: 151, February, 1931). The use of the term "dental caries in the rat" means exactly what the term implies and does not carry with it any implication or suggestion that such carie[illegible] the rat is the same as that known as human dental [illegible]es.

This speculation, namely, that the caries in the rats arises because of particle size, is open to criticism on a number of points That portion of corn which passes through a sixty-mesh screen has properties which are different from whole ground corn aside from the differences in physical size, and if size of particle was the controlling factor, then oatmeal, which contains large particles, should also cause caries in the diets which they fed However, oatmeal, as reported by those workers, does not produce caries.

It is the purpose of the present communication to direct attention to the rôle which phosphorus plays in the occurrence of such caries as the above-mentioned writers report

Discussion

As indicated in the preceding paragraphs, reports on the relation of diet to the incidence of dental caries in rats would indicate that high caries incidence may result from the rats receiving a diet containing large particles of whole ground corn.

If the calcium and phosphorus content of the diets reported by these workers is determined, interesting correlations are established between the occurrence of caries in rats and the level of phosphorus fed, as is indicated in Table I It will be noted from the table that as the amount of phosphorus is increased in the diet the incidence of caries decreases, the ratio of calcium to phosphorus remaining practically constant.

A study of these phosphorus values seems to indicate that size of particle is not the factor which controls the incidence of caries in the rat, since oatmeal does not produce caries in the proportions as fed by Hoppert, Webber and Canniff. The phosphorus figures, however, indicate that dental caries in the rat appears where phosphorus intake falls to 0.4802 grams per 100 grams of diet where Ca intake is .3424 per cent. Where oatmeal is substituted for the corn, the phosphorus content of the diet is increased to 0 5666 grams per 100 grams of diet, and when sifted corn, which is higher in phosphorus than whole ground corn (see Table II), is substituted for whole ground corn the phosphorus content of the diet is increased to 0 5282 grams per 100 grams of diet. In both of the latter instances the caries incidence is zero, where Ca intake is 4012 and 3490 per cent., respectively

For the past two years results in the McCollum rat colony have indicated that the level of phosphorus

TABLE I

Calculations* on the Diets Reported by Hoppert, Webber and Canniff

Diet	Parts	Phosphorus	Calcium	$\frac{Ca}{P}$ ratios	Caries	Nature of diet
Whole corn	60	1740	0084			
Milk powder	80	.2520	2760	$\frac{0\ 7}{1}$	Per cent ‡ 90–100	Coarse
Alfalfa	3	0071	0339			
Linseed meal	6	.0471	0241			
NaCl	1					
	100	4802	3424			
Oatmeal	60	2604	.0672			
Milk powder	30	2520	2760	$\frac{0\ 7}{1}$	Per cent ‡ zero	Coarse
Alfalfa	3	0071	.0339			
Linseed meal	6	.0471	.0241			
NaCl	1					
	100	5666	4012			
Corn sifting	60	2220	0150†			
Milk powder	30	2520	2760	$\frac{66}{1}$	Per cent ‡ zero	Fine
Alfalfa	8	.0071	0339			
Linseed meal	6	0471	0241			
NaCl	1					
	100	5282	3490			

* Calculations based upon figures given by Forbes.[4]

† This figure is for bolted cornmeal

‡ This information on percentage incidence supplied through the courtesy of Dr Hoppert by personal communication

TABLE II

Determination of Phosphorus in Whole Corn and Corn Siftings which Pass Through No 60 Sieve*

Substance	Sample weight	Treatment	Phosphorus in percentage per 100 grams of substance dried at room temperature
Whole cornmeal*	2 0003	ash	0.295
Hoppert sample	2 0513	ash	0.295
No 60 sifted corn*	2.0012	ash	0.370
Hoppert sample	2.0014	ash	0.3685

* These samples were kindly supplied by Dr. Hoppert.

---

[4] E. B. Forbes and M H. Keith. Technical series, Bull. No. 5, Agricultural Experiment Station, 1914.

in the diet is important in the production and prevention of experimental dental caries in rats. Eighty-eight per cent of rats fed a diet containing 0.23 grams of phosphorus per 100 grams of diet show dental caries at the end of 140 days of feeding. One hundred and forty rats fed diets containing 0.410 grams of phosphorus per 100 grams of diet show a percentage incidence of caries of 5 per cent.

The studies of McCollum, Simmonds, Park and Shipley, on bone growth and calcification, demonstrated the great importance, for the deposition of calcium salts in the osseous tissues, of certain ratios between these elements. The studies of Howland and Kramer, and others, have demonstrated the dependence of calcification on the inorganic phosphorus content of the blood, and especially on the product of the concentration of calcium and phosphate ions in the blood. We have found that a similar relation exists between blood composition and the incidence of dental caries. Using available data[5] on the composition of rat blood on diets unbalanced in calcium-phosphorus, we have been able to calculate that a critical level of blood phosphorus exists (10.5 ± 5 mg) under which rats develop caries and above which rats are immune from dental caries.

Blood phosphorus concentration is determined in great measure by total calcium, total phosphorus and total vitamin D intake. Therefore the maintenance of a level of blood phosphorus above the caries-immunity level (10.5 ± 5) is dependent upon these three factors. The level of phosphorus intake which will maintain the caries-immune level of blood phosphorus increases with increasing calcium intake and decreases with increasing vitamin D intake.

Summary

(1) Estimations of the phosphorus content of diets reported to produce caries in rats indicate that rations containing 0.4802 grams of phosphorus per 100 grams of diet, or less than 0.4802 grams of phosphorus per 100 grams of diet, tend to induce dental caries in rats if Ca intake is 0.3424 per cent.

(2) Estimations of the phosphorus content of diets reported to produce rats immune to dental caries indicate that such diets contain 0.5282 or more grams of phosphorus per 100 grams of diet and 0.4012 or less grams of calcium per 100 grams of diet.

(3) Experimental evidence is presented which indicates that the level of phosphorus in the diet is an important factor in producing caries-susceptibility and caries-immunity in rats.

(4) We have also found that a relation exists between blood composition (phosphorus) and the incidence of dental caries in rats. Caries arises in rats whose blood phosphorus falls below a critical level (about 10.5 ± .5 mg[6] of phosphorus per 100 grams of serum), while those rats whose blood phosphorus concentration is 10.5 ± .5 or above are immune from dental caries.

(5) It is indicated that this blood figure is dependent upon the level of phosphorus, calcium and vitamin ingested in the diet.

In a forthcoming paper we shall present the results of an extensive review of the recorded observations of our own and other laboratories on the relation between diet and susceptibility to dental caries in the rat and our conclusions from examining these data in the light of the working hypothesis (blood phosphorus critical level) here presented.

Henry Klein[7]
E. V. McCollum

ON THE ULTRA-VIOLET PHOTOMICROGRAPHY OF LIVING CELLS

An important advantage of the ultra-violet microscope in biology is its ability to photograph directly many cell structures which ordinarily are seen only in fixed and stained preparations. In this way one can study these structures without fear that they may be coagulation artifacts. To do this with complete assurance, however, it is often necessary to work with living and not merely with fresh material. All the ultra-violet photographs thus far published have been made with the original microscope of Köhler (Zeiss)[1] or the modification due to Barnard (as built by Beck)[2]. These instruments, though well suited to the photography of fixed preparations, require exposures which are too long for living cells both because of the highly injurious action of the ultra-violet light and because of the loss of fine detail through Brownian movement and protoplasmic streaming.

It has been found that only simple modifications are required to give photographs with the immersion objectives in from $\frac{1}{25}$ to $\frac{1}{5}$ of a second. Resolution approaching the theoretical maximum has been reached in pictures of living cells made under these conditions. We have furthermore observed that many kinds of cells if carefully shielded from all extraneous radiation are seemingly unhurt by the amount of ultra-violet light necessary to photograph them. Consequently it has been possible to prepare serial photographs which show many single cells and simple organisms passing through successive stages in their life histories. As would be expected from the conspicuous absorption of formed chromatin, this "motion picture" procedure has proved especially instructive in studies of cell division.

---

[5] Benjamin Kramer and J. Howland. In press.

[6] This figure is obtained by relating the calcium, phosphorus and vitamin D intake and percentage incidence of caries of the Hoppert, Webber and Canniff rats, with the blood calcium and phosphorus values of Kramer and Howland.

[7] Research fellow supported by grants from the American Dental Association and the Dental Staff of the Johns Hopkins Hospital.

[1] A. Köhler, *Zeit. f. wiss. Mik.*, 21: 129, 273 (1904); *ibid.*, 24: 360 (1907); A. Köhler and F. Togby, *Arch. f. Augenheilk.*, 99: 263 (1928); E. Grawitz and Gruneberg (photography by A. Köhler), "Die Zellendes menschlichen Blutes im ultraviolettem Licht" (Leipzig, 1906); H. v. Schrötter, *Virch. Arch. f. Path. Anat. u. s. w.*, 183: 343; F. F. Lucas, *Proc. Nat. Acad. Sci.*, 16: 599 (1930); *J. Morph.*, 52: 91 (1931).

[2] J. E. Barnard, *Lancet*, 2: 117 (1925); *J. Roy. Mic. Soc.*, 47: 253 (1926); R. W. G. Wyckoff and A. L. Ter Louw, *J. Exp. Med.*, 54: 449 (1931).

The microscope used is a Barnard instrument adapted to take Zeiss optics and modified in various minor details of its construction. Reduced exposure and irradiation times have been achieved (1) by employing as source a sufficiently powerful condensed spark discharge (between cadmium electrodes), (2) by refining mechanical features so that the correct focal plane for the ultra-violet light *can always* be reached after applying an empirical correction to the setting for green light and (3) by photographing on fine grained motion picture film at moderate initial magnifications and enlarging from the negatives. It should be remarked that after these modifications ultra-violet photographs can be made with practically the same ease and certainty that attend ordinary photomicrography with visible light.

This apparatus and the "slow motion picture" technique which it makes possible are being applied to the study of a number of biological problems. With A. H. Ebeling photographs[3] have been made of various tissue cells in mitosis. We have also photographed the growth of yeast, several steps in the reduction divisions leading to the production of grasshopper sperm and some stages in the life cycles of typical protozoa. These will be published at a later date, together with a detailed description of the microscope itself.

Ralph W. G. Wyckoff
Adrian L. Ter Louw

Rockefeller Institute for
Medical Research,
New York, N. Y.

ELEMENT 87

The isolation of element 87, reported in the press on October 15, 1931, offers another opportunity to test the validity of the periodic classification. The accompanying curves indicate certain properties of the alkali elements, and have been extended to cover the properties of element 87 by extrapolation. The values so obtained are subject to the usual objections common to extrapolated figures, but it will be interesting to see how closely they will conform to the observed properties of element 87 when the element has been completely studied.

Figs. 1, 2, 3 and 4 represent, respectively, the

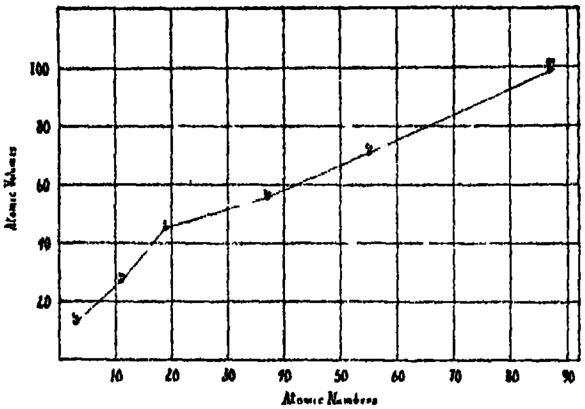


Fig. 1. Atomic volumes of the alkali elements plotted against their atomic numbers, with the value for element 87 extrapolated.

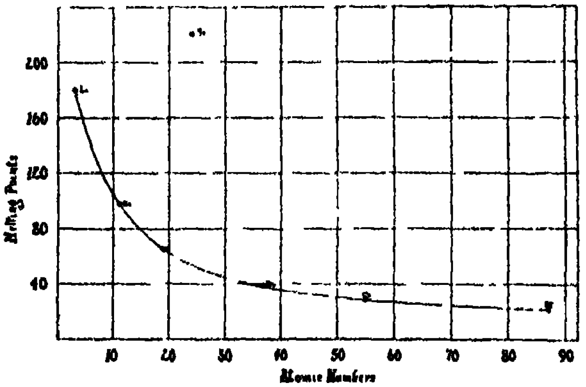


Fig. 2. Melting points of the alkali elements plotted against their atomic numbers, with the value for elements 87 extrapolated.

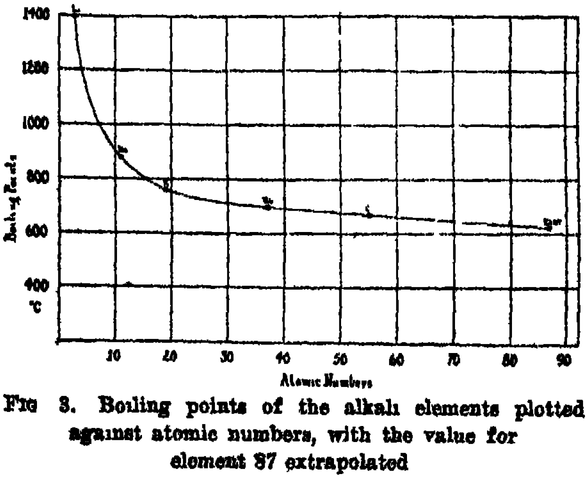


Fig. 3. Boiling points of the alkali elements plotted against atomic numbers, with the value for element 87 extrapolated.

---

[3] A few of our earliest photographs will appear in a forthcoming number of the *Journal of Morphology*.

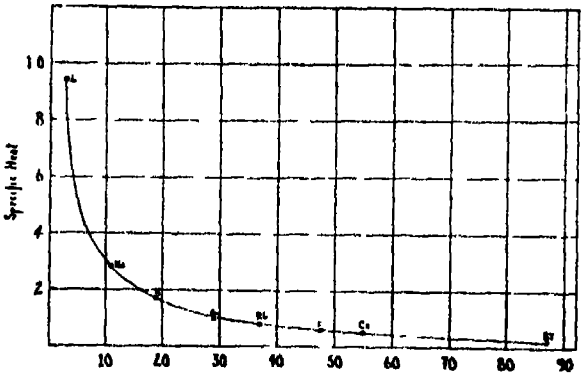


Fig 4 Specific heats of the alkali elements plotted against their atomic numbers, with the value for element 87 extrapolated

atomic volumes, melting points, boiling points and specific heats of the alkali elements, when plotted against their atomic numbers, with the value for element 87 extrapolated in each instance

Fig 5, representing the wave-lengths of maximum photoelectric sensitiveness of the alkali elements in contact with argon, has been plotted from the values given by Miss E F Seiler in the *Astrophysical Journal,* Vol 52, 1920, and is for the metals in comparatively thick layer

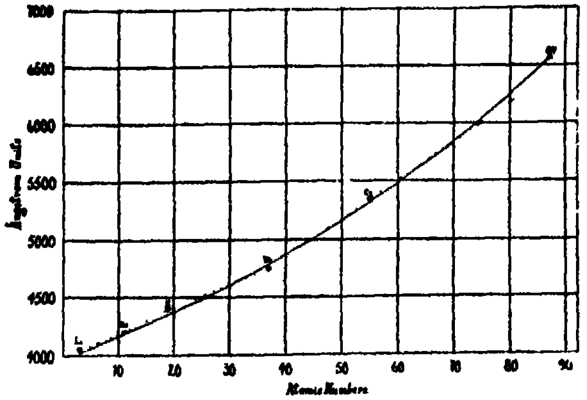


Fig 5 Wave lengths of maximum specific photoelectric sensitiveness of the alkali elements in contact with argon, plotted against their atomic numbers, with the value for element 87 extrapolated

Fig 6 is a composite curve from two curves showing the sensitivity curve of the caesium on caesium oxide photocell (solid line) and the analogy curve for a similar cell made with element 87, assuming that the same wave-length difference between caesium and element 87 would occur in cell and in maximum photoelectric sensitiveness of curve 5 The curves from which the composite was drawn are from Koller (*J O S A* and *R S. I.*) and Zworykin and Wilson ("Photocells and Their Application"). Since the sensitivity peaks broaden and flatten with increasing atomic number, a photocell utilizing element 87 might have a considerable sensitivity well into the infra-red

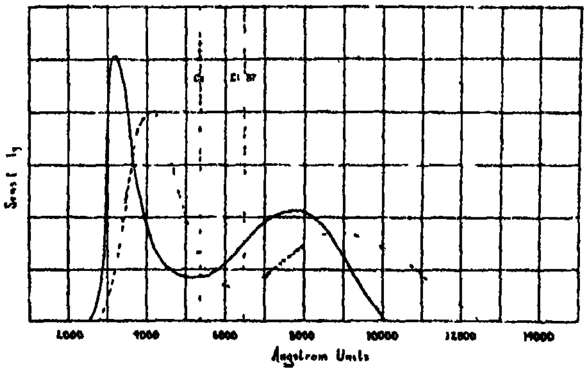


Fig 6 Photoelectric sensitivity curve of caesium in monatomic layer on caesium oxide, solid line Analogy curve for element 87, dotted line The vertical dotted lines represent the wave-lengths of maximum specific photoelectric sensitiveness shown in Fig 5 for Cs and El 87

From the atomic volume, the specific gravity of element 87 may be calculated as approximately 2 2 Its large atomic number makes it probable that several isotopes exist Since the radioactive degeneration series does not pass through the element, there is no reason to expect that it will be radioactive to any greater degree than the other alkali elements It should be possible to separate the element from admixture with caesium by differential light ionization in an electrostatic field, since presumably the vapors of the two elements would be ionized at different light frequencies

C F Graham

Albany, N Y.
Oct 17, 1931

BOOKS RECEIVED

Barger, George *Ergot and Ergotism* Pp xvi + 279 41 figures Gurney and Jackson, London. 15s

Blachowskie, Stefan *Kwartalnik Psychologiczny* Pp 350–460 Poznanskie Towarzystwo Psychologiczne, Poznan

Kodak Research Laboratories Vol XIV, 1930 Abridged Scientific Publications. Pp viii + 295 Illustrated Eastman Kodak Company.

Nachtsheim, Hans *Verhandlungen des I. Internationalen Kaninchenzuchter-Kongresses, Leipzig, 1930* Pp x + 283 Illustrated Reichs-Zentrale fur Pelztier, Leipzig

Schmidt, Johs *Report on the Danish Oceanographical Expeditions, 1908–1910 to the Mediterranean and Adjacent Seas* Part I, Pp 193. Part II, Pp. 21. Part III, Pp. 14 Part IV, Pp. 11 Illustrated. Host & Son, Copenhagen

Societe D'Anthropologie De Paris. *Bulletin and Memoires* 1929 Pp xxii + 199 Illustrated. 1930: Pp xxiv + 24 La Societe D'Anthropologie, Paris

Turner, L. B *Wireless* Pp xviii + 528 342 figures. 31 plates Cambridge University Press, Macmillan. $8 50.

I. A R I. 75.

IMPERIAL AGRICULTURAL RESEARCH
INSTITUTE LIBRARY
NEW DELHI

Date of issue	Date of issue.	Date of issue
3.11.51		
25.5.52		
26.6.57		
22 MAR 1954		
17 AUG 1978		